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ABSTRACT

The effects of home-based programming for infants and young children with hearing impairments and their families were studied, with a focus on the SKI*HI program, which includes identification/screening, home visits, support services, parent advisors, and a program management system. The study analyzed data on 5,178 children (ages birth to 5) with hearing impairments from the SKI*HI National Data Bank. Study objectives were to determine: the demographic characteristics of children receiving home-based intervention and effects of these factors on child achievement; the effectiveness of identification procedures for hearing loss; and aspects of the home intervention. To assess program effectiveness, consideration was given to such factors as: the length of time of the intervention and the frequency of home visits; the types of communication methodology employed; types of home services provided (e.g., speech and hearing therapy); child outcomes (e.g., posttests of receptive and expressive language ability); parent outcomes (e.g., learning auditory skills); and subsequent child placement. Appendices include a SKI*HI data sheet and instructions. (Contains 93 references.) (SW)

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ED 385 966

FINAL REPORT

Project No. H023C90117

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RESEARCH ON THE EFFECTS OF HOME INTERVENTION ON HEARING-IMPAIRED CHILDREN AND THEIR FAMILIES

July 1, 1979 to June 30, 1991

Carol J. Strong, Research Director

Thomas C. Clark, Project Director

August, 1992

Submitted to

U. S. DEPARTMENT OF EDUCATION

OFFICE OF SPECIAL EDUCATION AND REHABILITATIVE SERVICES

RESEARCH IN EDUCATION OF THE HANDICAPPED

FIELD-INITIATED RESEARCH

The findings, conclusions, opinions, and recommendations in this report are those of the authors and do not necessarily reflect the views of the funding agency.

EC304160

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ABSTRACT

Research on the Effects of Home Intervention on Hearing-Impaired Children and Their Families

Carol J. Strong and Thomas C. Clark

SKI*HI is a home-based program for infants and young children with hearing impairments and for their families. The major goals of the program are to identify hearing-impaired children as close to birth as possible and to provide them and their families with complete home programming that will facilitate development. The delivery model for the program includes identification/screening services, home-visit services, support services, and program management. The "heart" of the service is provided by a parent advisor, who makes weekly home visits to families. The parent advisor works closely with parents and with other members of a multi-disciplinary team to assess, plan, and provide appropriate home-based services for all family members.

The SKI*HI National Data Bank was initiated in 1979 and by the completion of this investigation contained information on more than 5,000 hearing-impaired children (ages 0 through 5 years of age) and their families. The problem addressed by this research project was the lack of a complete analysis and synthesis of the information in the National Data Bank for educators of children with hearing impairments and for researchers. The specific objectives were (a) to describe the demographic characteristics of the children who received home-based intervention and to study the relationship of these characteristics with child achievement; (b) to study the effectiveness of identification procedures for hearing loss; and (c) to investigate aspects of home-based intervention, including amount, intensity, and time of program start, on the language development of infants and young children with hearing impairments.

A pretest/posttest, single-group design was used rather than a comparison-group design. To control for maturation, the pre/post gains of the children were studied using predictive models. From July 1979 through June

1991, personnel from 143 different agencies, representing 30 states and one Canadian province, submitted data on 5,178 hearing-impaired children (ages 0 through 5 years) and on their families. All data submitted to the National Data Bank were included in the analyses. For the identification-procedure data and for the follow-up data related to placement after SKI*HI, personnel from 45 different agencies, representing 15 states, submitted data for 1,404 children. These data were collected for the July 1986 through June 1989 program years.

Demographic, test, and parent/child data were collected using the SKI*HI Data Sheet. Identification-procedure and program-placement data were collected using a questionnaire specifically developed for the study. The standardized language-assessment instrument was the Language Development Scale. Demographic, test, and parent/child data were collected by trained parent advisors and were submitted to the site coordinators, who then submitted the data to the National Data Bank. Identification-procedure and program-placement data were collected by the site coordinators and then were submitted to the National Data Bank. All data coding and entry was checked for accuracy.

The major accomplishments of SKI*HI were (a) that SKI*HI children showed higher rates of development during intervention than prior to intervention and greater gains in receptive and expressive language development than would be expected due to maturation alone (in addition to which they showed pre- to posttest developmental gains that were statistically significant and that yielded effect sizes indicating important practical effects); (b) that SKI*HI children showed increased auditory, communication-language, and vocabulary developmental levels and increased full-time hearing aid use; (c) that SKI*HI parents showed increased ability to manage their child's hearing handicap, communicate meaningfully with their child, and promote their child's cognitive development; and (d) that SKI*HI children were identified at an early age and began to receive home programming services promptly after identification.

(331 pages)

DEDICATION

To the children in the SKI*HI network

ACKNOWLEDGEMENTS

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CHAPTER 1

INTRODUCTION

The devastating impacts of hearing impairments on children and their families are well documented (Bailey & Simeonsson, 1988; Blair, 1981; Clark, 1989; Featherstone, 1980; Luterman, 1979; Stoneman & Brody, 1984; Turnbull & Turnbull, 1986). Not only does the child with a hearing impairment need early intervention to stimulate communication and cognitive development, but the parents need support and guidance in adjusting to having a child with a hearing impairment and in promoting the child's development.

The SKI*HI Model was conceived and developed in Utah as a comprehensive model for the early identification of children with hearing impairments and for providing home-based intervention for such children, birth through five years of age. Administered by the Utah School for the Deaf, SKI*HI was funded as a Demonstration Model by the U.S. Department of Education, Handicapped Children's Early Education Program (HCEEP) from 1972 to 1975. In 1975, SKI*HI received HCEEP Outreach funding. The SKI*HI Model was first validated by the Joint Dissemination Review Panel as an exemplary educational program in 1978 and was revalidated in 1984 and 1990. The SKI*HI Model has been adopted by approximately 260 agencies in the United States, Canada, and Britain and is used with more than 4,000 children and their families annually.

The SKI*HI Model is based on a theoretical framework which assumes that early identification and provision of family-focused, home-based programming will ameliorate the negative effects of hearing impairment on the child. Further, it is assumed that such programming will enable family members to adjust to the impairment, support and enjoy the child, and promote the child's development. This theoretical framework is strongly supported in the literature (Bailey & Simeonsson, 1988; Grant, 1987; Luterman, 1987; Simmons-Martin, 1983; Stein, Clark, & Kraus, 1983; Tingey, 1988). The language input a child receives during the early years of life is crucial to his or her acquisition of communicative/linguistic competence and later academic skills. A child who suffers early language deprivation experiences profound negative effects on all areas of language and literacy development (Allen, 1986; Clark, 1988; Jensema, Karchmer, & Trybus, 1978; McAnnally, Rose, & Quigley, 1987; Oller, 1985; Quigley, 1978; Quigley & Paul, 1986). Language deprivation can affect other areas of development as well, such as socialization and cognitive performance (Meadow, 1980; Moores, 1987; Sanders, 1988). The child with a hearing impairment and the child's family need early, family-focused, cost-efficient intervention. The SKI*HI Model addresses these needs.

The major goals of SKI*HI are to identify such children early and to provide complete, home-based programming that will facilitate their communicative, auditory, cognitive, and linguistic development. Specific goals for the *child* are that he or she will (a) communicate meaningfully with significant persons in the home; (b) use residual hearing; (c) develop a communication method (aural/oral, total communication, or other); (d) develop optimal receptive and expressive language levels; (e) be provided with maximum amplification; and (f) be prepared to enter school ready to learn. Specific goals for the *parents* are that they will (a) have a warm, positive relationship with the child; (b) provide a stimulating, interactive home environment; (c) be able to manage the child's hearing aids; (d) help the child use his or her residual hearing; and (e) provide communication-language and cognitive stimulation.

The SKI*HI home-based delivery model consists of the following components: (a) identification/screening; (b) direct services in the home for children with hearing impairments and their families; (c) support services (e.g., physical and occupational therapy, audiological services, medical and psychological support services) for the child; and (d) a program management system (see Figure 1).

Background, the Problem, Description of the Data Bank

In 1973, Project SKI*HI began collecting demographic and test data on children with hearing impairments who were being served by personnel using the SKI*HI model. In 1979, a national data bank for children being served by personnel in the SKI*HI network was started. Initially, this data bank contained information collected annually on 40 children. Data contributions

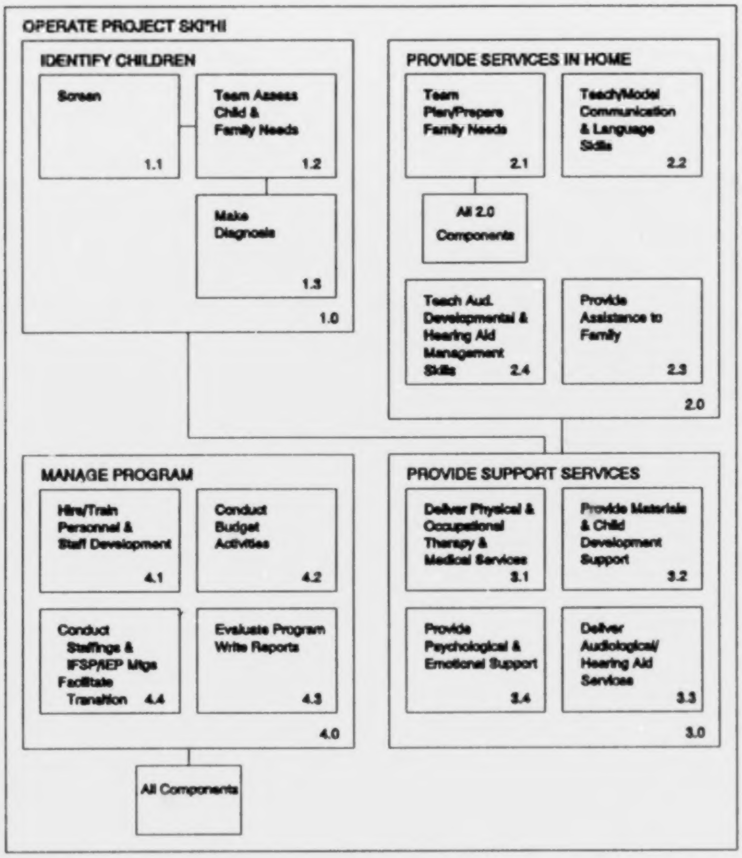
OPERATE PROJECT SKI*HI
IDENTIFY CHILDREN
Screen 1.1
Team Assess Child & Family Needs 1.2
Make Diagnosis 1.3
1.0
PROVIDE SERVICES IN HOME
Team Plan/Prepare Family Needs 2.1
Teach/Model Communication & Language Skills 2.2
All 2.0 Components
Teach Aud. Developmental & Hearing Aid Management Skills 2.4
Provide Assistance to Family 2.3
2.0
MANAGE PROGRAM
Hire/Train Personnel & Staff Development 4.1
Conduct Budget Activities 4.2
Conduct Staffings & IFSP/IEP Mtgs Facilitate Transition 4.4
Evaluate Program Write Reports 4.3
4.0
PROVIDE SUPPORT SERVICES
Deliver Physical & Occupational Therapy & Medical Services 3.1
Provide Materials & Child Development Support 3.2
Provide Psychological & Emotional Support 3.4
Deliver Audiological/ Hearing Aid Services 3.3
3.0
All Components

Figure 1. Program design for Project SKI*HI

increased steadily; by 1987 the data bank contained information on over 2200 children with hearing impairments. These children were from 81 different agencies, representing 27 states and one Canadian province. It was anticipated that by 1991 the number of children would increase to approximately 5000. This rich source of information on demographics, early identification, and effectiveness of home-based programming had not yet been analyzed, synthesized, and disseminated.

It is not that there had been no previous reports on the demographics of children with hearing impairments, identification procedures, and effectiveness of home-based programming. We have identified several reports

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that provide such information. However, the reports are typically limited to findings for small numbers of children being served in specific regions over a brief time span. The SKI*HI National Data Bank provides longitudinal information for children served throughout the United States that has never been available before and is available in no other place. The data have been used for the validation and revalidation of Project SKI*HI by the National Diffusion Network and for Annual Reports from the SKI*HI Institute to adoption agencies and other relevant recipients. The absence of a complete analysis and synthesis of the information in the SKI*HI National Data Bank for educators of children with hearing impairments and for researchers was the problem addressed by the research project presented on the following pages. The purpose of the project was to provide research findings on critical areas of home-based programming for children with hearing impairments and their families.

CHAPTER 2

REVIEW OF THE LITERATURE

Primary research studies are designed and conducted within the context of a review of prior research. A brief review of the literature for each of the three major research emphases (i.e., demographics, identification procedures, and effectiveness of home-based programming for children with hearing impairments) of this project follows.

Demographics

The most current demographic information on children with hearing impairments is provided by the Center for Assessment and Demographic Studies (1991) at Gallaudet University in Washington, D.C. As a part of the 1990-91 Annual Survey of Hearing Impaired Children and Youth, Gallaudet University published a regional and national summary of demographic information for 47,973 individuals with hearing impairments. Because the Gallaudet Center collects information on children and youth of all ages and only 13.5% of the reported data pertain to children who are birth through 5 years of age, their values must be interpreted with caution when comparisons are made with the SKI*HI data.

Data will be summarized from the Gallaudet report for only those variables that are consistent with the variables in the SKI*HI National Data Bank (i.e., gender, ethnicity, severity of hearing loss, cause of hearing loss, presence/absence of other handicapping conditions, age at onset of hearing loss, primary method of teaching, and classroom integration with hearing students). These data will be used later in this report to support our contention that the findings reported hereinafter for SKI*HI children are representative of hearing-impaired children nationally. Comparison data were not available for the following variables that are included in the SKI*HI National Data Bank: (a) type of hearing loss; (b) language spoken in the home; and (c) whether one or both parents had a hearing loss.

Table 1

Demographic Information Provided by the Center For Assessment and Demographic Studies at Gallaudet University for the Year 1990-91

Variable	Frequency	Percentage
Gender		
Male	25,834	53.9
Female	21,986	45.8
Unknown or Blank	153	.3
Ethnicity		
Caucasian	29,466	61.4
African American	8,112	16.9
Spanish American	6,628	13.8
Native American	340	.7
Asian American	1,683	3.5
Other	602	1.3
Multi-ethnic background	280	.6
Information Not Reported	862	1.8
Severity of Hearing Loss		
Normal	4,103	8.6
Mild	4,448	9.3
Moderate	5,683	11.8
Mod. Severe	5,728	11.9
Severe	8,637	18.0
Profound	18,141	37.8
Information Not Reported	1,233	2.6
Cause of Hearing Loss		
Unknown and Not Reported	24,859	51.8
Meningitis	4,160	8.7
Heredity	6,265	13.1
Otitis Media	1,746	3.6
Prematurity	2,212	4.6
Other Cause at Birth	2,338	4.9
Maternal Rubella	1,349	2.8
Cytomegalovirus	500	1.0
Other Complications of Pregnancy	1,251	2.6
Trauma at Birth	1,120	2.3
High Fever	1,202	2.5
Infection	1,021	2.1
Measles	133	.3
Mumps	27	< 1
RH Incompatibility	218	.4
Trauma After Birth	346	.7
Other Cause After Birth	894	1.9
Presence/Absence of Other Handicaps		
No Additional Handicaps	33,005	68.8
One or More Additional Handicaps	13,799	28.8
Not Reported	1,169	2.4

Table 1 (Continued)

Variable	Frequency	Percentage
Age at Onset of Hearing Loss		
At Birth	22,870	47.7
Under 3 years	7,291	15.2
3 years or older	1,927	4.0
Not Reported	15,885	33.1
Primary Method of Teaching		
Auditory/Oral Only	18,640	38.9
Sign and Speech (Total Comm.)	27,554	57.4
Sign Only	613	1.3
Cued Speech	214	.4
Other	343	.7
Not Reported	609	1.3
Classroom Integration with Hearing Students		
Integrated	25,388	52.9
Not Integrated	22,047	46.0
Not Reported	538	1.1

Identification Procedures

Because hearing loss is not readily observable, when such a handicapping condition is present at birth, the loss may go undetected for months or even years (Bess & McConnell, 1981). A hearing impairment can affect language acquisition, which in turn can lead to social, emotional, academic, and vocational difficulties (Moores, 1987). Identifying children with hearing impairments at or near birth allows early intervention, thus minimizing the cumulative effects of delayed language development (Mahoney & Eichwald, 1986). Further, late identification, after one year of age, results in stimulus deprivation, which can lead to central nervous system processing problems (Young, 1976). Support for these contentions is provided by Clark (1979), who reported that children with hearing impairments who receive intervention prior to 2 1/2 years of age have significantly better communication skills than children who receive comparable intervention beginning after 2 1/2 years of age. In fact, the Joint Committee on Infant Hearing (1982), which consists of professionals from the American Academy of Pediatrics, the American Academy of Otolaryngology--Head and Neck Surgery, the American Nurses Association, and the American Speech-Language-Hearing Association, recommended that the hearing of infants at-risk for hearing loss be screened not later than six months of age and that intervention for children with congenital hearing impairment be initiated soon after the child is six months of age. In 1990, the federal government established a goal to "reduce the average age at which children with significant hearing impairment are identified to no more than 12 months" by the year 2000 (U. S. Department of Health and Human Services, p. 460).

The World Health Organization (WHO) reported in 1967 that the incidence of severe hearing loss in neonates and infants was about 1:1000 and that the incidence of all degrees of hearing loss is approximately 5:1000 (cited in Abramovich, Hyde, Riko, & Alberti, 1987). Ideally, every neonate would be screened for hearing loss; however, in practice, neonatal hearing screening is not routinely done, primarily because of cost considerations (Northern & Gerkin, 1989).

Although infant hearing screening has been recommended for over 20 years, there continues to exist the underlying problem of not identifying the hearing impaired infant until 2 1/2 to 3 years of age (Mahoney, 1984). From a national perspective, according to a report released in 1988 by the Commission on Education of the Deaf to the President and the Congress of the United States, "the average age of identification for profoundly deaf children in the United States is reported as 2 1/2 years" (p. 3). In a survey conducted in Oregon, prior to the implementation of hearing screening via a statewide birth certificate high-risk registry, Moore, Josephson, and Mauk (1991) reported an average age at confirmation of loss of 30.6 months.

Earlier average ages of identification have been reported, however. Elssmann, Matkin, and Sabo (1987) conducted a survey in Arizona of 300 parents of children with hearing impairments. With 64% (n = 159) of the parents responding to the questionnaire, the average age of identification for those children was approximately 19 months. Elssmann et al. also reported that there was an inverse relationship between age of identification and severity of hearing loss. That is, those children with profound hearing losses were identified earliest (15 to 16 months), as compared with 18 to 22 months for children with severe losses, and 22 to 42 months for children moderate losses. This finding is consistent with the findings of other investigators (e.g., Coplan, 1987; Malkin, Freeman, & Hastings, 1976; Mauk, White, Mortensen, & Behrens, 1991; Shah, Chandler, & Dale, 1978).

The findings from the Elssmann et al. (1987) questionnaire also indicated that 79% of the children had been born with hearing losses and that only for those infants born with microtia/atresia was intervention begun at the age recommended by the Joint Committee on Infant Hearing. Further, Elssmann et al. stated that children with acquired losses from illness (e.g., meningitis) had experienced delays of approximately 8.5 months between the illness and hearing-aid fitting. Finally, they suggested that audiologists had contributed, on average, a delay of as much as six additional months between identification of the hearing loss and initial hearing-aid fitting.

Hearing Screening Techniques

Because hearing impairment cannot be observed in the neonate when examined by the pediatrician, techniques other than physical examination must be employed to detect the presence of a hearing loss. Screening techniques currently available are discussed below, as well as problems specific to each screening technique.

Behavioral observation audiometry. Traditionally, neonatal or infant hearing screening has been dependent on behavioral observation audiometry (BOA) (Mahoney & Eichwald, 1986). BOA screening of neonates and infants has evolved from use of clackers, bells, whistles, and various toys as sound stimuli to the use of more sophisticated narrow- or wide-band noise generators (Garrity & Mengle, 1983). Observers note the arousal from sleep or the auropalpebral response (APR) as responses to sound stimuli, as well as changes in respiration, heart, and sucking rates (Garrity & Mengle, 1983; Parving, 1985).

BOA infant hearing screening programs have been fraught with difficulties and have produced significant false-positive and false-negative results (Jacobson & Jacobson, 1987). Furthermore, BOA infant hearing screening programs are not cost effective (Mahoney & Eichwald, 1986). In 1973, the American Speech-Language-Hearing Association formed a multidisciplinary Joint Committee on Infant Hearing to evaluate the status of neonatal and infant screening procedures. The Committee recommended that the use of mass BOA screening of neonates and infants be discontinued in favor of testing only those neonates and infants determined to be at risk according to accepted high-risk criteria (cited in Mahoney & Eichwald, 1986).

High-risk register. In 1976, the Joint Committee on Infant Hearing recommended that infants at risk for hearing impairment be identified by means of both high-risk criteria and physical examination (cited in Gerber & Mencher, 1983). A five-item high-risk register was developed and recommended for use as a screening procedure. By 1981, two additional risk criteria had been added to the original five. Consequently, the recommended high-risk register currently comprises seven risk criteria:

1. Family history of childhood hearing impairment.
2. Congenital perinatal infection (e.g., cytomegalovirus, rubella, herpes, toxoplasmosis, syphilis).
3. Anatomic malformations involving the head or neck (e.g., dysmorphic appearance including syndromal and nonsyndromal abnormalities, overt or submucous cleft palate, morphologic abnormalities of the pinna).
4. Birth weight less than 1,500 grams.
5. Hyperbilirubinemia at level exceeding indications for exchange transfusion.
6. Bacterial meningitis, especially Hemophilus influenza.
7. Severe asphyxia, which may include infants with Apgar scores of 0 to 3 or those who fail to institute spontaneous respiration by ten minutes and those with hypotonia persisting to 2 hours of age.

Although the high-risk register is not a hearing test per se, it is recognized as an infant hearing screening method. Several methods are used to collect the information related to the seven risk criteria. One successful method is used in Utah, where parents complete the high-risk register as a part of the legally required birth certificate application process (Mahoney & Eichwald, 1986). Other states in which a high-risk register has been mandated or in which requirements for a high-risk register are in the planning stages include Colorado, Kentucky, Oklahoma, Massachusetts, New Jersey, Tennessee, and Virginia.

Although the high-risk register is a logical procedure for selecting children for hearing testing, disagreement exists as to its usefulness, principally because only half of the children with a hearing loss will manifest a known risk factor (Abramovich et al., 1987). To address this problem, authors have proposed screening procedures in addition to the high-risk register. For example, Jaffe (1977) has reported that greater rates of identification of infants with hearing loss resulted when combinations of behavioral audiometry and a high-risk register were used. Abramovich et al. (1987) found that better detection rates were obtained if brainstem electrical response audiometry (BERA) was delayed until 3 or 4 months of age and if the high-risk register was used to select the children for testing. And Mencher (cited in Ramey & Trohanis, 1982) found that while 56% of the congenitally deaf children could be identified by behavioral testing, 80% could be identified if behavioral testing was combined with the high-risk register.

Immittance/impedance audiometry. Immittance/impedance audiometry provides an effective screening procedure for middle-ear pathology or conductive hearing loss by providing a measure of eardrum mobility (Garrity & Mengle, 1983). A typanogram (a graph of tympanic membrane movement) is printed out, and the examiner can evaluate middle-ear pressure and the mobility of the eardrum, which helps in determining the presence/absence of middle-ear pathology. The examiner can also use immittance/impedance audiometry to help detect sensorineural hearing loss by observing the presence/absence of an acoustic reflex. However, Parving (1985) reported that the use of immittance/impedance audiometry for screening the hearing of neonates and infants before approximately six months of age may not be effective.

Crib-O-Gram. The Crib-O-Gram screening procedure involves the use of a motion-sensitive transducer under the crib mattress which detects any motor activity from the infant, including respiration, stronger than an eye blink or facial grimace (Northern & Gerkin, 1989). The infant's state is monitored automatically by measuring crib movement for 10 to 15 seconds before and 6 seconds following each test-sound presentation. At Stanford Medical Center where the Crib-O-Gram was developed, 10 hearing losses in 9,429 births were detected using this procedure, for a total detection rate of 2.5:1000 (Jaffe, 1977). Malphurs (1989) reported that at the University of Mississippi Medical Center, the Crib-O-Gram was used for identifying neonates and infants with suspected hearing loss, those testing positive then being referred for auditory brainstem response testing.

Auditory brainstem response. The auditory brainstem response (ABR) has received the most attention of any infant hearing screening procedure in recent years (Cox, Hack, & Metz, 1984; Fria, 1985; Galambos, Hicks, & Wilson, 1984). When using ABR, the examiner measures the electrical and physiological response to an auditory signal by the brainstem (Northern & Downs, 1984). A series of clicking sounds is presented to the child through earphones to stimulate the auditory system. These electrical signals are amplified and the results are printed as wave forms by a computer.

Researchers generally agree that the ABR is the most objective measure currently available for assessing the peripheral auditory system in infants (Northern & Gerkin, 1989) and that it provides the most accurate index of hearing sensitivity for neonates (Galambos et al., 1984). The advantage of ABR testing over other "objective" auditory tests is that the response is relatively unaffected by subject state, sleep, and drugs (Cox et al., 1984). However, Madell (1988) indicated that because the ABR tests only for high-frequency hearing loss, it should be used only as part of a complete test battery that includes behavioral techniques.

Evoked otoacoustic emissions. The most recent technological breakthrough in hearing screening is evoked otoacoustic emissions (EOAE) testing, first described by Kemp in 1978 (cited in Johnson & Elberling, 1982). Kemp, the inventor of the procedure, indicated that an acoustic probe consisting of a miniature microphone and a sound source is sealed in the external ear canal. Acoustic energy is released into the ear canal by the cochlea, reflecting the existence of an active mechanism within the cochlea. It has been demonstrated that the evoked emission is not present in adults when hearing loss exceeds 15 dB (Stevens, Webb, Smith, & Buffin, 1990). Currently, studies are being conducted to determine the efficacy of this procedure with the neonatal population (Mauk, 1990). Recent research has demonstrated that the procedure is accurate, simple, fast, noninvasive, objective, and sensitive (Bonfils, Uziel, & Pujol, 1988).

Parental suspicion. Although recent advances in technology are promising, identification of hearing loss in neonates, infants, and toddlers is primarily the result of parental suspicion (Simmons, 1978). In fact, Simmons stated that the best instrument for detecting hearing loss in early childhood is a grandmother living nearby. A number of authors have supported Simmons's contentions: (a) Becker (1976) stated that parents detect 70% of the cases of hearing impairment; (b) Gustason (1989) reported that parents and grandparents are the most common source of early suspicion of hearing loss; and (c) Garrity and Mengle (1983) described the family as most often suspecting hearing problems.

Although parental suspicion generally occurs at around 9 to 10 months of age (Mahoney & Eichwald, 1986), such suspicion does not necessarily result in referral, confirmation of hearing loss, and intervention at an early age. Confirmation and remedial action are generally delayed until the child is 2 1/2 to 3 years of age (Mahoney & Eichwald, 1986). Shah et al. (1978) stated that the

> chief obstacles to diagnosis were the referring physicians' unwillingness to accept the parents' opinions, their failure to perform simple screening tests and their reluctance to arrange referrals. Detection was found to depend on the astuteness and insistence of parents, and on the alertness of their physicians. (p. 206)

Several authors have suggested that the only way to change the pattern of late confirmation and remedial action is to educate the pediatricians and general practitioners as to the importance of both early detection and heeding parents' opinions regarding their children (e.g., Bess & McConnell, 1981; Coplan, 1987; Shah et al., 1978).

Summary

In summary, although various neonatal or infant screening procedures are available, suspicion of hearing loss by parents is still the primary means by which most hearing-impaired children are identified. Evoked otoacoustic emission testing holds great promise for neonatal or infant hearing screening, but the research to support the validity and reliability of the technology as a neonatal or infant hearing screening procedure is still lacking. The data gathered for this investigation from the participating SKI*HI sites will add to the body of literature available in this critical area of investigation.

Program Effectiveness

Relatively few data exist on the effectiveness of home-based programming for infants, toddlers, and young children. In an early study, Clark (1979) described his investigation of children from the SKI*HI network who received early (prior to 30 months of age) versus late (after 30 months of age) home-based programming. Comparisons of the two groups' mean scores indicated that the children with early intervention obtained statistically significantly higher mean scores for measures of auditory development, receptive and expressive language, and parental involvement.

In a review of the literature, Meadow-Orlans (1987) identified eight reports, not including the Clark (1979) study, in which researchers had compared outcome measures for children with hearing impairments who had begun intervention "early" versus "late". All of the authors except one (Watkins, 1987) conducted their research with children from center-based or residential programs. Watkins's subjects were participating in programs using the SKI*HI home-based programming model. Meadow-Orlans noted conflicting findings for the eight reports. That is, while no statistically significant difference between the two groups' mean scores was reported for one of the studies

(Craig, 1964), for six of the studies (Balow & Brill, 1975; Brasel & Quigley, 1977; Greenstein, Greenstein, McConville, & Stellini, 1975; Levitt, McGarr, & Geffner, 1986; Liff, 1973; White & White, 1986), authors reported statistically significant differences, favoring the early intervention groups. Watkins (1987) also reported statistically significant differences favoring early as compared to late home-based intervention, but for only a few of the 23 dependent measures that she used in her study.

In addition to the review of findings from early versus late investigations, Meadow-Orlans (1987) also identified five reports in which researchers investigated the effects of some type of oral-plus-visual communication as compared to oral/aural communication in early intervention programs. Consistent findings favoring the oral-plus-visual communication methodology were reported for the five investigations (Greenberg, Calderon, & Kusche (1984); Moores, Weiss, & Goodwin, 1978; Musselman, Lindsay, & Wilson, 1985; Quigley, 1969 [2 reports]). Home-based programming was used in only one of these investigations (Greenberg et al., 1984) and an important characteristic of the experimental condition was that the early and intensive use of sign language was taught through family visits by a deaf adult.

Summary

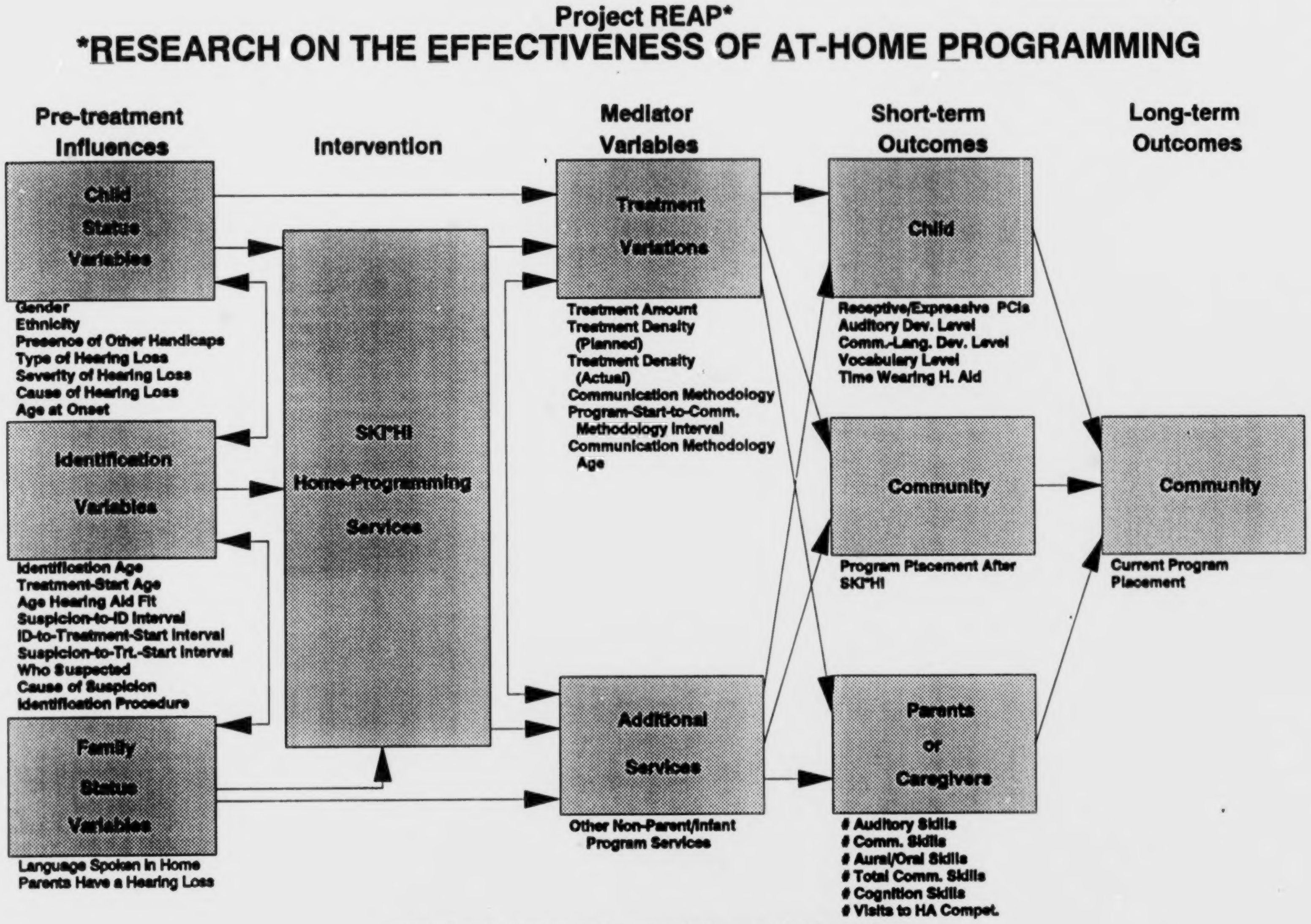
Preliminary findings from the accessible research literature indicate that early intervention, as compared to late intervention, results in greater communication and educational gains. Additionally, oral-plus-visual communication methodology has resulted in greater gains than oral-only methodologies. There have been few investigations of the effectiveness of home-based programming for children with hearing impairments--that is, only the studies by Clark (1979), Greenberg et al. (1984) and Watkins (1987) were located. And only the investigation by Greenberg et al. was conducted independently from the SKI*HI network.

CHAPTER 3

GENERAL PURPOSES, RESEARCH QUESTIONS, AND RESEARCH VARIABLES

The major goal of this investigation was to provide research data on the effects of home-based programming on children with hearing impairments and their families. To accomplish the major goal, three primary objectives were specified: (a) To describe the demographic characteristics of children receiving home-based intervention and to study the relationship of these characteristics with child achievement; (b) To study the effectiveness of identification procedures for hearing loss; and (c) to investigate aspects of home-based intervention, including amount, intensity, and time of program start on the language development of infants and young children with hearing impairments.

In Figure 2 the research paradigm for this investigation is presented. Pre-treatment influences included (a) child-status variables (i.e., gender, ethnicity, presence of other handicapping conditions, type of hearing loss, severity of hearing loss, cause of hearing loss, and age at onset of hearing loss); (b) family-status variables (i.e., language spoken in the home, and whether one or both parents had a hearing loss); and (c) identification variables (i.e., identification age, program-start age, hearing-aid-fit age, suspicion-to-identification interval, identification-to-program-start interval, suspicion-to-program-start interval, who suspected hearing loss, cause of suspicion, and identification procedure). The intervention component was the SKI*HI home-based programming model. Mediator variables included (a) treatment variations (i.e., treatment amount, planned treatment density, actual treatment density, communication methodology, and diagnosis-to-communication-methodology interval) and (b) additional services (i.e., other non-Parent/infant-Program services). Short-term and long-term outcomes included (a) child outcomes (i.e., receptive and expressive language scores, auditory-development level, communication-language-development level, vocabulary level, amount of time per day wearing a hearing aid, and threshold improvement with amplification); (b) parent/caregiver outcomes (i.e., number



Project REAP*

*RESEARCH ON THE EFFECTIVENESS OF AT-HOME PROGRAMMING

Pre-treatment Influences
Intervention
Mediator Variables
Short-term Outcomes
Long-term Outcomes
Child Status Variables
Gender
Ethnicity
Presence of Other Handicaps
Type of Hearing Loss
Severity of Hearing Loss
Cause of Hearing Loss
Age at Onset
Identification Variables
Identification Age
Treatment-Start Age
Age Hearing Aid Fit
Suspicion-to-ID Interval
ID-to-Treatment-Start Interval
Suspicion-to-Trt.-Start Interval
Who Suspected
Cause of Suspicion
Identification Procedure
Family Status Variables
Language Spoken in Home
Parents Have a Hearing Loss
SKI*HI Home-Programming Services
Treatment Variations
Treatment Amount
Treatment Density (Planned)
Treatment Density (Actual)
Communication Methodology
Program-Start-to-Comm. Methodology Interval
Communication Methodology Age
Additional Services
Other Non-Parent/Infant Program Services
Child
Receptive/Expressive PCIs
Auditory Dev. Level
Comm.-Lang. Dev. Level
Vocabulary Level
Time Wearing H. Aid
Community
Program Placement After SKI*HI
Parents or Caregivers
# Auditory Skills
# Comm. Skills
# Aural/Oral Skills
# Total Comm. Skills
# Cognition Skills
# Visits to HA Compet.
Community
Current Program Placement

SKI*HI Institute, Department of Communicative Disorders, Utah State University

Figure 2. Research paradigm.

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of auditory, communication, aural/oral, total communication, and/or cognition skills that the parents/caregivers acquired and number of visits needed to attain hearing-aid-competency skills); and (c) community outcomes (i.e., program placement immediately after home-based programming and current-program placement).

Demographics

The general purposes of the demographic portion of the study were (a) to describe the demographic characteristics of the hearing-impaired children receiving home intervention; and (b) to describe the demographic characteristics of specific subgroups of hearing-impaired children and their families (i.e., subgroups defined by gender, race, presence/absence of other handicapping conditions, type of hearing loss, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, presence/absence of parent with a hearing loss).

Child-Status Variables

Gender.

1. What percentage of the children were male and what percentage was female, overall and by program year?

Ethnicity.

1. What percentage of the children were Caucasian, African American, Asian American, Spanish American, Native American, and other nationalities, overall and by program year?
2. What was the magnitude of the relationship between ethnicity and gender?

Other handicapping conditions.

1. What percentage of the children had other handicapping conditions, overall and by program year?
2. What was the magnitude of the relationship between presence/absence of other handicapping conditions and gender? and ethnicity?

Type of hearing loss.

1. What percentage of the children had a conductive, sensorineural, or

mixed loss (i.e., type of hearing loss)?

2. What was the magnitude of the relationship between type of hearing loss and gender? and ethnicity? and presence/absence of other handicaps?

Severity of hearing loss.

1. What percentage of the children had a mild (25 - 40 dB), moderate (45 - 60 dB), severe (65 - 90 dB), or profound (>90 dB) unaided hearing loss (i.e., unaided-hearing-loss severity) overall and by program-start year?
2. What was the relationship between unaided-hearing-loss severity and gender? and ethnicity? and presence/absence of other handicaps? and type of hearing loss?

Cause of hearing loss.

1. What percentage of the children had hearing losses caused by each of the following: (a) cause unknown/not reported, (b) hereditary, (c) maternal rubella, CMV, or other infections during pregnancy, (d) meningitis, (e) defects at birth, (f) fever or infections in child, (g) RH incompatibility or kernicterus, (h) drugs during pregnancy, (i) other pregnancy conditions--e.g., prematurity, (j) middle-ear problems or ENT anomalies, (k) drugs administered to child, (l) birth trauma, (m) child syndrome, and (o) other.
2. What was the magnitude of the relationship between cause of hearing loss and gender? and ethnicity? and presence/absence of other handicaps? and type of hearing loss? and severity of hearing loss?

Age at onset of hearing loss.

1. For what percentage of the children was the age at onset of hearing loss at birth, birth to one year of age, one year to two years of age, two years to three years of age, or three years to six years, overall and by program-start year?
2. What was the magnitude of the relationship between age at onset of hearing loss and gender? and ethnicity? and presence/absence of

other handicaps? and type of hearing loss? and severity of hearing loss? and cause of hearing loss?

Family-Status Variables

Language spoken in the home.

1. For what percentage of the children was each of the following languages the primary language spoken in the home: (a) English, (b) American Sign Language (ASL), (c) Spanish, (d) Signed English System, or (e) other language?
2. What was the magnitude of the relationship between language spoken in the home and gender? and ethnicity? and presence/absence of other handicaps? and type of hearing loss? severity of hearing loss? and cause of hearing loss? and age at onset of hearing loss?

Parent(s) with hearing loss.

1. For what percentage of the children did one or both parents have a hearing loss, overall and by project year?
2. What was the magnitude of the relationship between presence/absence of parent with a hearing loss and gender? and ethnicity? and presence/absence of other handicapping conditions? and type of hearing loss? and severity of hearing loss? and cause of hearing loss? and age at onset of hearing loss? and language spoken in the home?

Finally, we will ask the question "what was the relationship between each of the demographic variables and pretest receptive and expressive language quotients?"

Identification Procedures

The general purposes for the identification-procedure portion of the study were to: (a) determine the magnitude of the relationship between identification procedure (e.g., crib-o-gram, high-risk register, audiological testing, parental suspicion and referral) and the following three identification variables: identification age, time interval between suspected-hearing-loss age and identification age, and time interval between identification age and program-placement age; (b) determine the optimal linear relationship between the identification variables and pretest receptive and expressive language scores.

Identification Variables

Identification age.

1. What were the mean and median ages at which the hearing loss was identified (i.e., identification age in months), overall and by program year?
2. What was the magnitude of the relationship between identification age and the following demographic variables: gender, ethnicity, presence of other handicaps, type of hearing loss, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Program-start age.

1. What were the mean and median ages at which the program was started (i.e., program-start age in months), overall and by program year?
2. What was the magnitude of the relationship between program-start age and the following demographic variables: presence of other handicaps, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Hearing-aid-fit age.

1. What were the mean and median ages at which the hearing aid was fit (i.e., hearing-aid-fit age in months), overall and by program year?
2. What was the magnitude of the relationship between hearing-aid-fit age and the following demographic variables: presence of other handicaps, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Time interval between suspicion of a hearing loss and identification.

1. What were the mean and median time intervals, in months, between suspected-loss age and identification age, overall and by program year?

2. What was the magnitude of the relationship between suspicion-to-identification interval and the following demographic variables: presence of other handicaps, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Time interval between identification and program-start.

1. What were the mean and median time intervals, in months, between identification age and program-placement age, overall and by project year?
2. What was the magnitude of the relationship between identification-to-program-start interval and the following demographic variables: presence of other handicaps, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Time interval between suspicion and program-start.

1. What were the mean and median time intervals, in months, between suspicion age and program-start age, overall and by project year?
2. What was the magnitude of the relationship between suspicion-to-program-start interval and the following demographic variables: presence of other handicaps, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Who suspected?

1. What percentage of the children were suspected to have a hearing loss by caregivers, medical personnel, educators, other specialists, and health/human services personnel?
2. What were the mean and median identification ages, program-start ages, hearing-aid-fit ages, suspicion-to-identification time intervals, identification-to-program-start time intervals, and suspicion-to-program-start time intervals for each of the categories of individuals who suspected a hearing loss?

3. Was there a statistically significant difference among the mean ages and time intervals for the categories of individuals who suspected a hearing loss? What was the magnitude of the differences (i.e., standardized mean differences, _SMD_s)?

Cause of suspicion.

1. What was the relative incidence of each factor that caused an individual to suspect a hearing loss?
2. What were the mean and median identification ages for each of the causes of suspicion of a hearing loss?
3. Was there a statistically significant difference among the mean ages for the cause-of-suspicion categories? What were the magnitudes of the differences (i.e., standardized mean differences, _SMD_s)?

Identification procedures.

1. What percentage of the children were identified by each of the identification procedures?
2. What were the mean and median identification ages, program-start ages, hearing-aid-fit ages, suspicion-to-identification time intervals, identification-to-program-start time intervals, and suspicion-to-program-start time intervals for each of the identification procedures?
3. Was there a statistically significant difference among the mean ages and intervals for the identification procedures? What were the magnitudes of the differences (i.e., standardized mean differences, _SMD_s)?

All variables.

1. What was the magnitude of the relationship among the following variables: identification age, program-start age, hearing-aid-fit age, suspicion-to-identification time interval, identification-to-program-start time interval, suspicion-to-program-start time interval, pretest LDS receptive language quotients, and pretest LDS expressive language quotients?

2. Which linear combination of identification variables best predicted pretest receptive and expressive language quotients?

Program Effectiveness

The general purposes of the program-effectiveness portion of the study were to: (a) determine the effect of treatment variations (i.e., treatment amount, planned and actual treatment density, communication methodology, communication-methodology age, and diagnosis-to-communication-methodology interval), of additional services(i.e., other non-parent/infant-program services), and of program-start age on receptive and expressive language gains; (b) determine the effectiveness of SKI*HI home-based intervention as evidenced by expressive and receptive language developmental rates, gains in auditory, communication-language, and vocabulary levels, time wearing hearing aid and threshold improvement, parent-skill acquisition, program-placement immediately after SKI*HI, and current placement in the community.

Treatment Variations

Treatment amount.

1. What, for all children pooled, was the mean amount of time spent in the program?
2. What was the magnitude of the relationship between treatment amount and the following demographic variables: presence of other handicaps, severity of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Planned treatment density.

1. For what percentage of the children were home visits scheduled to be conducted twice a week, weekly, every other week (or bi-monthly), monthly, and irregularly?
2. For what percentage of the children did the planned frequency of home visits change?

Actual treatment density.

1. What were the mean and median actual numbers of visits per month, overall?

2. What was the magnitude of the relationship between actual treatment density and the following demographic variables: presence of other handicaps, severity of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?

Communication methodology.

1. What percentage of the children used an auditory (aural/oral), total communication, or other communication methodology, overall?
2. What was the magnitude of the relationship between communication methodology and the following demographic variables: presence of other handicaps, severity of hearing loss, age at onset of hearing loss, language spoken in the home, and parental hearing loss?
3. What were the mean and median ages at which a communication methodology was selected?
4. What were the mean and median time intervals between program start and choice of a communication methodology?
5. For what percentage of the children did the communication methodology change?

Additional Services

Other Non-Parent/Infant-Program services.

1. What percentage of the children received the following services (other than the home-programming services): (a) educational, (b) mental health, (c) health, (d) social, (e) mental retardation, (f) speech and hearing therapy, (g) combination (educational + speech and hearing therapy), and (h) other services or combination of services?

Child Outcomes

Receptive and expressive language.

1. Was there a statistically significant difference between the mean pre- and posttest LDS scores? between the mean actual and predicted posttest scores? What was the magnitude of the difference (i.e., SMDs?)
2. What were the mean and median PCIs, overall and by program year?

3. Was there a statistically significant difference among the mean and median PCIs by gender? by ethnicity? by presence/absence of other handicapping condition? by type of hearing loss? by severity of hearing loss? by cause of hearing loss? by age at onset of hearing loss? by language spoken in the home? by presence/absence of hearing-impaired parent? by treatment amount? by actual treatment density? by communication methodology?
4. Using value-added analysis, what was the mean growth experienced by children above and beyond what would have been expected from maturation alone, overall and by program year?
5. Did the added-program value differ by severity of hearing loss? by communication methodology?
6. What was the magnitude of the relationship among the following variables: treatment amount in months, actual treatment density, program-start age in months, posttest receptive language scores, and posttest expressive language scores?
7. What optimal linear combination of treatment variables best predicts LDS receptive and expressive language posttest scores?

Child-competence outcomes.

1. For what percentage of the children was the hearing aid worn less than 1/4 time, 1/4 to 1/2 time, 1/2 to 3/4 time, over 3/4 time, and all of the time? What were the mean and median amounts of time (in months) that it took to attain each of the levels?
2. What were the mean and median threshold improvements for the unaided hearing-loss-severity levels.
3. For what percentage of the children was Auditory-Development Level 1 the highest level attained and what were the mean and median amounts of time (in months) that it took to attain that level? (The same questions will be asked for Auditory-Development Levels 2 through 11.)
4. For what percentage of the children was Communication-Language Development Level 1 the highest level attained and what were the mean

and median amounts of time (in months) that it took to attain that level? (The same questions will be asked for Communication-Language Development Levels 2 through 12.)

5. For what percentage of the children was Vocabulary-Interval Level 1 the highest level attained and what were the mean and median amounts of time (in months) that it took to attain that level? (The same questions will be asked for Vocabulary-Interval Levels 2 through 8.)

Parent Outcomes

Parent/caregiver-competence outcomes.

1. What were the mean and median numbers of auditory skills acquired by the parent? The standard deviation?
2. What was the average time (in months) that it took to attain the auditory skills?
3. What were the mean and median numbers of communication skills acquired by the parent? The standard deviation?
4. What was the average time (in months) that it took to attain the communication skills?
5. What were the mean and median numbers of aural/oral language stimulation skills acquired by the parent? The standard deviation?
6. What was the average time (in months) that it took to attain the aural/oral language stimulation skills?
7. What were the mean and median numbers of total communication skills acquired by the parent? The standard deviation?
8. What was the average time (in months) that it took to attain the total communication skills?
9. What were the mean and median numbers of cognition skills acquired by the parent? The standard deviation?
10. What was the average time (in months) that it took to attain the cognition skills?
11. What were the mean and median numbers of visits needed for the parent to achieve 80 to 100% accuracy on the hearing-aid competency test?

The standard deviation?

Community Outcomes

Program placement after SKI*HI.

1. What percentage of the children, upon completion of home intervention programming, were placed in the following settings: (a) residential program, (b) day school for the deaf, (c) self-contained classroom in a public school, (d) mainstreamed classroom in a public school, (e) other?

Current program placement.

1. What percentage of the children are currently placed in the following settings: (a) residential program, (b) day school for the deaf, (c) self-contained classroom in a public school, (d) mainstreamed classroom in a public school, (e) other?

CHAPTER 4

PROCEDURES

The description of procedures for this investigation of the demographics, identification procedures, and program effectiveness for children served by the SKI*HI model from 1979 through 1991 follows the traditional format. With the problem statement, literature review, and research questions presented in earlier chapters, the rest of this chapter addresses the design, subjects, instrumentation, data collection, and analyses.

Design

Because services to identified children could not ethically be denied in light of earlier evidence of program effectiveness (JDRP certification of SKI*HI, 1978, 1984), and after a careful consideration of the alternatives (White & Pezzino, 1986), a pretest-posttest, single-group design was used rather than a comparison-group design. Without a comparison group, options for analysis are few. However, predictive models are common in the literature (e.g., Bryk & Weisberg, 1976; Bryk & Woods, 1980; Shonkoff & Hauser-Cram, 1989; Weisberg, 1974). To control for maturation, the pre-post gains of SKI*HI children were studied in four ways, using predictive models: (a) mean posttest scores were compared with mean predicted posttest scores--the predicted mean scores indicated what the children would have scored as a result of maturation alone (Sheehan, 1979); (b) intervention developmental rate was compared with pretest developmental rate using Proportional Changes Indices (PCIs) (Wolery & Bailey, 1984); (c) growth associated with maturation was compared with growth over and above maturation using value-added analysis (Bryk & Weisberg (1976); Bryk & Woods (1980); Hebbeler, 1985; Markowitz, Hebbeler, Larson, Cooper, & Edmister, 1991); and (d) multiple-regression analysis was used to determine the optimal linear combination of treatment variables for predicting posttest language scores.

Subjects

Target and Accessible Populations

The purpose of this study was to analyze and synthesize the information in the national data bank on children with hearing impairments who had been served by the SKI*HI model. Therefore, the target population was all children who have been served by the SKI*HI model. In recent years, approximately 250 agencies have used the SKI*HI model, serving approximately 5000 children annually. However, participation in the national data bank by adoption-site personnel is completely voluntary and done without monetary compensation. For example, during 1989-90, personnel from 28% (n=69) of the sites participated in the national data bank, representing approximately 20% of the children being served for that year. The accessible population was, then, all children who received SKI*HI intervention since 1979 and for whom data were submitted to the SKI*HI National Data Bank.

Sample

Because all data submitted to the national data bank were included in the analyses for this study, the accessible population and the sample are identical. Between July 1979 and June 1991, personnel from 143 different agencies, representing 30 states and one Canadian province, had submitted data for 5,178 children (Table 2). However, because complete records were not available for every child, sample sizes for specific variables vary throughout this report. Because demographic summaries for the children are reported in Chapter 5 of this report, further characteristics of the children will not be elaborated here.

Instrumentation

Language-Development Scale

When Project SKI*HI was first validated in 1979, the primary measure of both expressive and receptive language (up to the language age of 36 months) was the Receptive-Expressive Emergent Language Scale (REEL). The REEL was standardized on normal hearing children. By the time of SKI*HI revalidation in 1984, this instrument had been replaced by the SKI*HI Language Development Scale (LDS) (Tonelson & Watkins, 1979), which was developed by Project SKI*HI personnel and validated specifically for young hearing-impaired children.

The SKI*HI Language Development Scale (LDS) lists the expressive and

Table 2

Location, Number of Sites, and Number of Children in the National Data Bank Between 1979 and 1991, Ages Birth Through 72 Months at Program Start

States and One Foreign Country	Number of Sites	Number of Children	% Of Children
Alaska	1	20	0.4
Arkansas	12	371	7.2
Connecticut	1	12	0.2
Florida	3	12	0.2
Georgia	1	564	10.9
Iowa	2	31	0.6
Indiana	1	81	1.6
Kansas	3	15	0.3
Louisiana	1	27	0.5
Maine	4	8	0.2
Michigan	12	79	1.5
Minnesota	6	43	0.8
Mississippi	2	56	1.1
Missouri	1	171	3.3
North Dakota	1	25	0.5
Nebraska	4	11	0.2
New Mexico	1	144	2.8
New York	3	68	1.3
Ohio	10	131	2.5
Oklahoma	2	195	3.8
Oregon	1	19	0.4
Pennsylvania	4	65	1.2
South Carolina	1	125	2.4
Tennessee	2	447	8.6
Texas	55	1552	30.0
Utah	1	715	13.8
Virginia	1	20	0.4
West Virginia	1	3	0.1
Wisconsin	1	1	<.1
Wyoming	1	1	<.1
Unidentified Sites	6	8	0.2
Canada	3	158	3.1
Total	146	5178	100

receptive language skills that a child of a particular age would normally demonstrate. Unlike other scales, the LDS does not emphasize auditory items. In addition, children who use total communication are not penalized on this scale as they are on many other language-development scales. The child is given credit for understanding and use of signs. Credit is also given for misarticulated verbal responses. Therefore, hearing-impaired children are not penalized for their disability.

The data gathered for the reliability and validity study were obtained from children in SKI*HI programs across the country. Three different procedures were used to estimate the reliability of the LDS: (a) The percentage of agreement among 23 examiners was calculated by having the examiners observe, via videotape, children manifesting language behaviors. Inter-examiner agreement was 80% and 78% for the receptive and expressive scales, respectively. (b) Intra-examiner agreement (or test-retest reliability) was estimated by correlating examiners' responses from observation one and observation two. Intra-examiner agreement was .86 and .92 for the receptive and expressive scales, respectively. (c) Finally, internal consistency coefficients, calculated from the completed scales of 115 hearing-impaired children, were .93 and .94 for the receptive and expressive scales, respectively.

Two different procedures were used to estimate the validity of the LDS: (a) The concurrent validity of the LDS was estimated by correlating scores on the LDS with scores on the REEL. Coefficients of .78 and .79 were obtained for the receptive and expressive scales, respectively. (b) With respect to construct validity, the coefficients of reproducibility as determined by the Guttman scaling technique were uniformly high for both units and individual items within units. A .99 coefficient of reproducibility was obtained for both the receptive and expressive scales.

SKI*HI Data Sheet

The SKI*HI Data Sheets (Appendix A) were developed by SKI*HI Institute personnel. A copy of the Data Sheet and detailed instructions for its completion (Appendix B) are provided in all SKI*HI manuals. The most recent version of the SKI*HI manual, entitled Programming for Hearing Impaired Infants Through Home Intervention: SKI*HI Home Visit Curriculum (4th ed.) (Clark & Watkins, 1985), provides the instructions on pages 70 through 87.

A formal study of the reliability and validity of the entries on the data sheets was conducted in 1990 in conjunction with a study of the reliability and validity of a questionnaire that was developed to investigate identification procedures. For 8% (n = 116) of the 1,404 children whose demographic data was included in the identification-procedure study (to be described later in this section), inter-examiner agreement data were sought for their SKI*HI Data Sheets. The children were randomly selected from each of the sites participating in the identification-procedure study. Inter-coder agreement responses were returned for 85% of the children (n = 99). For 21 of those children, the agency no longer had the children's records, so the duplicate data sheets could not be completed. For the remaining 78 children for whom the responses could be used, average inter-coder agreement for the data sheet was 87%, with a standard deviation of 10%, and a median of 88%.

Prior to 1985, the Data Bank was located at the University of Virginia Evaluation Research Center, and data were entered there for all but the 1982-83 year. The computer database for 1979-82 and 1983-85 was then moved to Utah, along with the data sheets that had been submitted for the 1982-83 year. For the 1982-83 year and for all years beginning with 1985-86, the following data-entry procedures were used. When the data sheets were received at the SKI*HI Institute, carefully trained data coders encoded the data onto a Data Coding Instrument (Appendix C), using coding conventions developed by the Research Director (Appendix D). To control for the consistency and accuracy of data coding, intercoder-agreement checks for every 20 data sheets were conducted prior to computer entry (intercoder agreement was consistently above 90%) and disagreements were resolved. Furthermore, all computer entries were checked for accuracy.

REAP Questionnaire

A questionnaire (Appendix E) was developed for the purposes of learning

(a) which method of screening for hearing loss in infants was dominant among children served by the SKI*HI model; (b) which hearing-screening method resulted in the earliest mean age of identification for infants; (c) which hearing-screening method resulted in the earliest program placement; and (d) where children were placed after receiving services from a program using the SKI*HI model. The one-page questionnaire included both closed and open questions. Structurally, the questions were clear and as brief as possible. Few technical words were used. Closed questions were asked first, followed by open questions.

A pilot study was undertaken at the Utah Parent/Infant Program to determine if (a) the questions could be answered using information in children's files; (b) the questions were understandable; and (c) office personnel could complete the questionnaire or if it was necessary for the supervisor to complete the questionnaire. During January, 1990, a first draft of the questionnaire was piloted, using 10 children randomly selected from children enrolled in the Utah Parent/Infant Program between 1987 and 1989. The instructions and the 10 questionnaires were first given to the secretary of the Utah program. After the secretary had completed the 10 questionnaires, the supervisor of the Utah program and the researcher reviewed the files for the same 10 children to determine if the supervisor responded differently to the questions. Based on this pilot data, the questionnaire was modified and it was determined that the supervisor had access to more background information and could better interpret the information in the children's files than the secretary.

Again, when the questionnaires were received at the SKI*HI Institute, carefully trained data coders encoded the data directly into a computer file, using coding conventions developed by the Research Director (Appendix F). All entries were verified for accuracy.

Inter-coder agreement estimates for 7% (N = 99) of the questionnaires were obtained in 1990. The average percentage of agreement was 82% (sd= 12%, median = 83%).

Data Collection

SKI*HI Data Sheet

As general SKI*HI procedure, at each project site demographic, LDS test, child development, and parent-skill data were collected by the parent advisor (PA) on the SKI*HI Data Sheets, designed specifically for submission to the SKI*HI Data Bank (Appendix A). (See Appendix G for a summary of the Utah PAs' experience, education, and certification for the 1990-1991 program year.) The PAs received thorough training in the completion and submission of the data sheets. The careful training included a description of and orientation to the data-collection system and the data sheets; practica, spaced throughout training, on making entries on the data sheets; and feedback from trainers on the practicum experiences. Detailed printed instructions were provided to each new PA and to each program supervisor (Appendix B). Parent advisors and their supervisors were encouraged to contact the SKI*HI Institute whenever a question arose as to data collection and reporting. All testing was done by the parent in conjunction with the SKI*HI PA, who made weekly visits to the home. Replication site personnel submitted the data to the SKI*HI Data Bank annually for analysis.

Because the PA administered all annual pre- and posttests in conjunction with the parent and records weekly parent- and child-progress data, the PA knew the child's pretest scores (i.e., examiners without knowledge of pretest scores cannot be used). The SKI*HI model is an educational model for delivery of services to the families of children with hearing impairments in their homes, many of which were in rural areas. Nearly all services were provided in the home, including the testing of the children and the advisement of parents. As a working, replicable educational model for delivery of services in the home, the SKI*HI model required that the PA do both the testing and providing of services to the family and child. Consequently, financial resources for hiring someone other than the PA to travel to the home to do the testing were not available, leaving instrumentation as a potential threat to the internal validity of the study's findings.

REAP Questionnaire

In the July 1989, site coordinators for all SKI*HI adoption sites submitting data to the National Data Bank were contacted by letter requesting their participation in additional data collection (Appendix H). Coordinators from 57 sites agreed to participate in additional data collection; however, for 11 of those sites, there were no data in the National Data Bank on any of their children. Consequently, coordinators from 46 sites actually participated in the additional data collection. For these 46 sites, demographic and test data for a total of 1,467 children had been submitted to the National Data Bank.

Before sending the questionnaires to the coordinators, the child identification numbers were recorded on the questionnaires for every child enrolled during any of three years (i.e., 1986-87, 1987-88, or 1988-89). Instructions for completing the questionnaires were photocopied onto the back of each form (Appendix E). Along with a copy of the signed participation agreement (Appendix H) and a letter describing the importance of the additional data, the questionnaires were mailed to each coordinator, for completion within 30 days. In addition, as a reward for participating, each site was sent a check at the following rates: (a) one to twenty-four children--$20; (b) 25 to 49 children--between $25 and $50; (c) 50 to 99 children--between $60 and $85; (d) 100 to 149 children--up to $150; and (e) 150 children or more--$200. As a reminder, coordinators who did not return the questionnaires within the specified timeline were telephoned. All site coordinators returned the questionnaires, except one, for a 96% response rate.

Data Analysis

For all interval- and ratio-scale variables, basic descriptive statistics were computed--means, modes, medians, standard deviations, and ranges. For nominal- and ordinal-scale variables, frequencies and percentages were computed, as well as two-way frequency tables, with Cramer's *V* calculated to estimate the magnitude of the relationship between the variables. Two-way frequency tables were used to illustrate possible interactions between variables, especially demographic characteristics and treatment variations.

The approach was designed to demonstrate how the characteristics of the children in our accessible population, especially pre-treatment influences (e.g., severity of hearing loss or presence of other handicapping conditions) and treatment variations (e.g., communication methodology or treatment density), were related.

For the analysis of child progress, first LDS test scores were transformed to Intervention Efficiency Indices (IEI) (Bagnato & Neisworth, 1980) by dividing the developmental gain between the pre- and posttest by the time between the pre- and posttest. The IEI was then divided by the pretest developmental rate (PDR) (i.e., PDR = pretest developmental age divided by the pretest chronological age [CA]). These transformations yielded Proportional Change Indices (PCIs).

$$IEI/PDR = \underline{PCI}$$

Children whose rates of development were slower during intervention than at pretest received a PCI of less than 1.0, and those whose rates of development accelerated during intervention received a PCI greater than 1.0 (Wolery, 1983).

An inherent problem in the analysis of progress for infants and young children is maturation. Sheehan (1979) suggested using initial testing information for predicting a child's performance in the future and for comparing pretest developmental rates with developmental rates during intervention. The procedure has been criticized because it is based on the assumption that development occurs at a consistent rate and, therefore, it does not address the problem of growth spurts. It should be remembered that chances of growth spurts are equally distributed at pre- and posttest times. In the case of pretest scores, the growth spurt would be reflected in the developmental rate, which would then be reflected in the predicted posttest score. Strong correlations, ranging from .90 to .93, between pre- and posttest scores were obtained, further supporting this argument.

Second, observed LDS receptive and expressive posttest scores were compared to predicted posttest scores. As for the first data analysis, each child's pretest developmental rate (PDR) was determined by dividing his or her pretest developmental age by the pretest CA. The posttest CA of the child, in months, was then multiplied by the PDR to determine a predicted posttest score. The predicted posttest score was used as a standard against which to compare the observed posttest score.

PDR x Posttest CA = Predicted Posttest Score

In conjunction with the other analyses, the comparison of predicted with observed posttest scores provides an indication of program effectiveness as compared to what would be expected due to maturation alone.

Third, dependent t-tests were used to determine if the differences between the pre- and posttest LDS receptive mean scores and the pre- and posttest LDS expressive mean scores were statistically significant. Dependent t-tests were also used to determine if the differences between the observed posttest mean scores and the predicted posttest mean scores were statistically significant.

Fourth, value-added analysis (Bryk & Weisberg, 1976; Hebbeler, 1985; Markowitz et al., 1991) was used to estimate the "value-added by the program above and beyond that which would have been without the program" (Hebbeler, 1985, p. 2). Using the total distribution of scores for the pretest "to approximate the longitudinal growth rate that children would display in the absence of intervention as they grow older" (Markowitz et al., 1991, p. 378), pretest scores were regressed on pretest CA to obtain a coefficient that indicates the growth rate prior to the pretest. For each child, the regression coefficient was then multiplied by the amount of time the child was in the program to estimate the amount of growth due to maturation alone. To determine the child's total growth, the pretest score was subtracted from the posttest score. Finally, the growth due to maturation was subtracted from the total growth to estimate the growth due to program participation (i.e., the value added). Hebbeler (1985) stated that

> The value-added method is not as prone to error due to developmental spurts because the growth rates are computed for the entire group or subgroups of children through a regression equation rather than for each child individually through the use of a ratio. (p. 3)

Value-added analysis also allows for other variables to be included in the equation in addition to pretest CA. For example, if hearing-loss severity interacts with pretest age, then hearing-loss severity could be included in the equation. Regression coefficients not only were computed for the children overall but also for subgroups of children (e.g., aural/oral vs. total communication).

Fifth, one-way analyses of variance were conducted to determine the statistical significance of differences between/among mean PCIs. If a significant F was obtained, the Tukey multiple-comparison technique was used to determine which differences between means were statistically significant. In addition, because the median more validly reflects average performance when a distribution of scores is skewed, nonparametric statistics (i.e., the two-sample median test or the k-sample median test) were used to determine the statistical significance of differences between/among median PCIs.

Sixth, multiple regression was used to determine the optimal linear combination of treatment variables that best predicted expressive and receptive language developmental rates during intervention.

Finally, SMDs were calculated by dividing the difference between the pre- and posttest means by the pretest standard deviation to determine the magnitude of the difference between the mean scores. Cohen's (1988) standards of .2 as a small effect size, .5 as a medium effect size, and .8 as a large effect size were used as arbitrary, though reasonable, criteria to judge the magnitude of SMDs.

Summary

In this chapter, the procedures followed in conducting this investigation have been spelled out, with considerable detail regarding instrumentation and data collection. The outline of our approach to data analysis has been sketched. The details will be filled in as some information about our accessible population is presented in the next chapter, followed by the results of our analyses of the data.

CHAPTER 5

DEMOGRAPHIC CHARACTERISTICS OF THE SUBJECTS

The major concern in conducting this investigation of home-based programming for children with hearing impairments was to analyze and synthesize the information in the SKI*HI National Data Bank for educators of children with hearing impairments and for researchers. To set the context for characterizing the relevant findings from the data collected from 1979-1991 and to address the first general purpose of the investigation, which was to describe the demographic characteristics of the children, we present in this chapter some general information about the population of children and their families for whom data were submitted to the Data Bank. We will first present the information related to the children's status prior to the program, followed by information related to the families' status. (The pronoun "we" in this chapter and in those that follow refers to the Project staff.)

Lastly, we asked the question "Were the demographic variables associated with child expressive or receptive language status at the time program services began?" To address that question, we will present the findings from analyses of variance that were conducted for each of the demographic variables, using pretest expressive and receptive language quotients as dependent variables. A quotient is a ratio of language age to chronological age times 100. It should be emphasized that only pretest scores were used for these analyses. The findings related to program effectiveness using posttest language scores as dependent variables will be reserved for Chapter 7.

As noted in Chapter 4, data for 5,178 children were submitted to the SKI*HI National Data Bank between July 1979, and June 1991. In some instances, parent advisors failed to submit complete data for each child. Consequently, total sample sizes will vary for the demographic variables discussed below, which include gender, ethnicity, presence of other handicaps, type of hearing loss, severity of hearing loss, cause of hearing loss, age at onset, language spoken in the home, and presence of parent with a hearing impairment. For every demographic variable, we will present two-way frequency tables describing the relationships between the variables.

Child-Status Variables

Gender

One question of interest was whether the percentages of male and female children were relatively equal, overall and for each of the program years since 1979. Inspection of Tables 3 and 4 indicates that overall and for all program-start years, except 1987-88, the percentage of males was slightly greater than the percentage of females (i.e., 55% and 45%, respectively). These data were consistent with those provided by Gallaudet (Table 1). Gender information was not reported for 2 1/2% of the total population of children.

Table 3

Frequencies and Percentages of Children by Gender, 1979-1991

	N	%
Male	2772	55
Female	2276	45
Total	5048	100

Note: Total children possible = 5,178.

For Table 4, and for all tables in which a relationship between two nominal-scale variables is depicted, Cramer's V will be reported. Cramer's V is a coefficient which describes the strength of a relationship between two nominal variables. The coefficient always varies between 0 and 1, regardless of the size of the table (Welkowitz, Ewen, & Cohen, 1982). For 2 x 2 tables, Cramer's V equals the Phi coefficient. For Table 4, Cramer's V equaled .05, which indicated that there was practically no relationship between program-start year and gender. That is, the percentages within the cells were what would be expected, based on the marginal (i.e., row and column) values. For coefficients that were small, moderate, and large in magnitude, we will identify those cell values that were larger or smaller than expected based on the marginal values.

Table 4

Frequencies and Percentages of Gender, Overall and by Program-Start Year

Program Year	Male		Female		Total N
	N	%	N	%	
7-1-79 thru 6-30-80	24	64.9	13	35.1	37
7-1-80 thru 6-30-81	79	59.0	55	41.0	134
7-1-81 thru 6-30-82	212	53.3	186	46.7	398
7-1-82 thru 6-30-83	323	55.8	256	44.2	579
7-1-83 thru 6-30-84	215	52.7	193	47.3	408
7-1-84 thru 6-30-85	237	57.5	175	42.5	412
7-1-85 thru 6-30-86	207	55.9	163	44.1	370
7-1-86 thru 6-30-87	294	55.0	241	45.0	535
7-1-87 thru 6-30-88	266	49.4	272	50.6	538
7-1-88 thru 6-30-89	308	55.8	244	44.2	552
7-1-89 thru 6-30-90	322	55.8	255	44.2	577
7-1-90 thru 6-30-91	285	56.1	223	43.9	508
Overall	2772	54.9	2276	45.1	5048

Note: Total children possible = 5,178.
Cramer's V = .05.

Ethnicity

Of interest, too, was what percentage of the children served by the participating sites had been minority children and whether the relative percentages for each ethnic group had differed by program-start year. The data in Tables 5 and 6 indicate that 72% of the children were Caucasian. This percentage was somewhat higher than that reported by Gallaudet (see Table 1). The remaining 28% of the children were primarily of African-, Spanish-, Native-, or Asian-American descent. The low Cramer's V (.07) reflects little change in the relative percentages of children from each ethnic group across the program-start years (Table 6). Information regarding the children's ethnic background was not reported for 3% of the total population.

The relationship between ethnicity and gender was practically nil (Cramer's V = .04). As Table 7 indicates, the percentages for male children were consistently greater than or similar to the percentages for female children for each of the ethnic groups.

Table 5

Frequencies and Percentages of Children by Ethnicity, 1979-1991

Ethnicity	N	%
Caucasian	3616	72.0
African American	726	14.4
Spanish American	470	9.4
Native American	109	2.2
Asian American	46	.9
Other	58	1.2
Total	5025	100.0

Note: Total children possible = 5,178.

Table 6

Frequencies and Percentages of Children by Ethnicity, Overall and by Program-Start Year

Program Year	Caucasian		African American		Spanish American		Native American		Asian American		Other		
	N	%	N	%	N	%	N	%	N	%	N	%	Total N
7-1-79 thru 6-30-80	29	82.9	4	11.4	2	5.7	-	-	-	-	-	-	35
7-1-80 thru 6-30-81	109	83.2	9	6.9	5	3.8	5	3.8	1	.8	2	1.5	131
7-1-81 thru 6-30-82	296	73.4	63	15.6	19	4.7	13	3.2	7	1.7	5	1.2	403
7-1-82 thru 6-30-83	415	71.4	88	15.1	39	6.7	24	4.1	6	1.0	9	1.5	581
7-1-83 thru 6-30-84	315	76.1	42	10.1	42	10.1	3	.7	6	1.4	6	1.4	414
7-1-84 thru 6-30-85	301	73.6	52	12.7	42	10.3	1	.2	2	.5	11	2.7	409
7-1-85 thru 6-30-86	273	73.8	45	12.2	40	10.8	5	1.4	2	.5	5	1.4	370
7-1-86 thru 6-30-87	391	73.9	81	15.3	38	7.2	9	1.7	6	1.1	4	.8	529
7-1-87 thru 6-30-88	389	73.7	86	16.3	42	8.0	7	1.3	3	.6	1	.2	528
7-1-88 thru 6-30-89	373	68.2	92	16.8	58	10.6	10	1.8	5	.9	9	1.6	547
7-1-89 thru 6-30-90	387	67.3	87	15.1	82	14.3	13	2.3	3	.5	3	.5	575
7-1-90 thru 6-30-91	338	67.2	77	15.3	61	12.1	19	3.8	5	1.0	3	.6	503
Overall	3616	72.0	726	14.4	470	9.4	109	2.2	46	.9	58	1.2	5025

Note: Total children possible = 5,178. Cramer's V = .07.

Table 7

Frequencies and Percentages of Males and Females by Ethnicity, 1979-1991

Ethnicity	Male		Female		Total	
	N	%	N	%	N	%
Caucasian	1979	39.9	1588	32.0	3567	71.9
African American	388	7.8	321	6.5	709	14.3
Spanish American	242	4.9	228	4.6	470	9.5
Native American	49	1.0	59	1.2	108	2.2
Asian American	26	.5	20	.4	46	.9
Other	36	.7	22	.4	58	1.2
Total	2720	54.9	2238	45.1	4958	100

Note: Cramer's V = .04. Total children possible = 5,178.

Other Handicapping Conditions

Because program effectiveness may be related to the presence of additional handicapping conditions, the parent advisors reported "yes" if the children had a professionally confirmed handicap, other than hearing loss. No data were collected regarding the types or the severity of the other handicapping conditions. Approximately 25% of the children served had a handicapping condition in addition to hearing loss (Table 8). This percentage was slightly lower than that reported by Gallaudet (see Table 1). A low Cramer's V (.08) reflects a small increase in the percentage of children with additional handicaps for the 1980-81 program-start year (Table 9). Information regarding the presence of another handicapping condition was not reported for 4% of the total population of children.

Table 8

Frequencies and Percentages of Children by Presence of Other Handicaps, 1979-1991

Type	N	%
Other Handicap Present	1227	24.7
Other Handicap Not Present	3747	75.3
Total	4974	100.0

Note: Total children possible = 5,178.

Table 9

Frequencies and Percentages of Children With Other Handicaps, Overall and by Program-Start Year

Program Year	Other Handicap Present		Other Handicap Not Present		Total N
	N	%	N	%	
7-1-79 thru 6-30-80	12	34.3	23	65.7	35
7-1-80 thru 6-30-81	47	35.1	87	64.9	134
7-1-81 thru 6-30-82	111	30.9	248	69.1	359
7-1-82 thru 6-30-83	145	26.3	407	73.7	552
7-1-83 thru 6-30-84	97	23.9	309	76.1	406
7-1-84 thru 6-30-85	112	26.8	306	73.2	418
7-1-85 thru 6-30-86	84	22.4	291	77.6	375
7-1-86 thru 6-30-87	117	22.0	416	78.0	533
7-1-87 thru 6-30-88	107	20.0	427	80.0	534
7-1-88 thru 6-30-89	130	23.7	418	76.3	548
7-1-89 thru 6-30-90	128	22.2	448	77.8	576
7-1-90 thru 6-30-91	137	27.2	367	72.8	504
Overall	1227	24.7	3747	75.3	4974

Note: Total children possible = 5,178. Cramer's V = .08.

Tables 10 and 11 indicate little relationship between the presence of other handicapping conditions and gender and between the presence of other handicapping conditions and ethnic background for the children in this study (Cramer's V = .03 and .06, respectively). Males were reported to have an additional handicapping condition more frequently than females, but not more frequently than expected given the marginal frequencies. Likewise, Caucasian children were reported to have an additional handicapping condition more frequently than minority children, but not more frequently than expected based on the marginal frequencies.

Table 10

Frequencies and Percentages of Children with Other Handicaps by Child's Gender, 1979-1991

Gender	Other Handicap Present		Other Handicap Not Present		Total	
	N	%	N	%	N	%
Male	697	14.2	1998	40.7	2695	54.9
Female	516	10.5	1702	34.6	2218	45.1
Total	1213	24.7	3700	75.3	4913	100.0

Note: Cramer's V = Phi = .03. Total children possible = 5,178.

Table 11

Frequencies and Percentages of Children with Other Handicaps by Child's Ethnicity, 1979-1991

Ethnicity	Other Handicap Present		Other Handicap Not Present		Total	
	N	%	N	%	N	%
Caucasian	848	17.3	2680	54.6	3528	71.9
African American	161	3.3	541	11.0	702	14.3
Spanish American	130	2.6	340	6.9	470	9.6
Native American	39	.8	66	1.3	105	2.1
Asian American	9	.2	36	.7	45	.9
Other	19	.4	38	.8	57	1.2
Total	1206	24.6	3701	75.4	4907	100.0

Note: Cramer's V = .06. Total children possible = 5,178.

Type of Hearing Loss

The vast majority (82%) of the children had sensorineural hearing losses (Table 12). No comparison data were available from Gallaudet for this variable. A small Cramer's *V* (.18) reflects some changes in the relative percentages across the program-start years (Table 13). For the 1990-91 year, the percentage of children with a conductive hearing loss was twice as large as it had been the prior two years. Additionally, for the 1982-83 and 1983-84 program-start years, the percentages of children with undetermined losses were three to four times the percentages of the preceding and succeeding years. Information regarding the type of hearing loss was not reported for 4% of the children.

Table 12

Frequencies and Percentages of Children by Type of Hearing Loss, 1979-1991

Type	*N*	%
Sensorineural	4081	82.1
Mixed	393	7.9
Conductive	333	6.7
Not Yet Determined	161	3.2
Total	4968	100.0

Note: Total children possible = 5,178.

Table 13

Frequencies and Percentages of Children by Type of Hearing Loss, Overall and by Program-Start Year

Program Year	Sensorineural		Conductive		Mixed		Undetermined		
	N	%	N	%	N	%	N	%	Total N
7-1-79 thru 6-30-80	32	94.1	2	5.9	-	-	-	-	34
7-1-80 thru 6-30-81	123	91.8	2	1.5	6	4.5	3	2.2	134
7-1-81 thru 6-30-82	339	85.4	19	4.8	20	5.0	19	4.8	397
7-1-82 thru 6-30-83	452	78.7	19	3.3	45	7.8	58	10.1	574
7-1-83 thru 6-30-84	310	73.8	30	7.1	24	5.7	56	13.3	420
7-1-84 thru 6-30-85	337	82.0	16	3.9	45	10.9	13	3.2	411
7-1-85 thru 6-30-86	306	84.3	17	4.7	38	10.5	2	.6	363
7-1-86 thru 6-30-87	447	87.0	23	4.5	43	8.4	1	.2	514
7-1-87 thru 6-30-88	457	86.9	21	4.0	44	8.4	4	.8	526
7-1-88 thru 6-30-89	442	81.5	46	8.5	50	9.2	4	.7	542
7-1-89 thru 6-30-90	469	82.1	51	8.9	50	8.8	1	.2	571
7-1-90 thru 6-30-91	367	76.1	87	18.0	28	5.8	-	-	482
Overall	4081	82.1	333	6.7	393	7.9	161	3.2	4968

Note: Total children possible = 5,178. Cramer's V = .18.

A low Cramer's V (.17) indicates a small relationship between type of hearing loss and presence of an additional handicapping condition (Table 14). (*Note*: Children whose type of hearing loss had been reported as "undetermined" were removed from this analysis.) Larger percentages of mixed and conductive losses were reported for children with additional handicapping conditions than would be expected based on the marginal proportions.

Table 14

Frequencies and Percentages of Children With and Without Other Handicaps by Type of Hearing Loss, 1979-1991

Type of Hearing Loss	Other Handicap Present		Other Handicap Not Present		Total	
	N	%	N	%	N	%
Conductive	121	2.6	205	4.4	326	6.9
Sensorineural	845	18.0	3135	66.8	3980	84.8
Mixed	171	3.6	217	4.6	388	8.3
Total	1137	24.2	3557	75.8	4694	100.0

Note: Cramer's V = .17. Total children possible = 5,178.

An even lower Cramer's V (.09) was obtained for the relationship between type of hearing loss and race (Table 15). That is, only slight differences in the cell values were observed as compared to those that would be expected based on the marginal proportions.

Table 15

Frequencies and Percentages of Children by Ethnicity and Type of Hearing Loss, 1979-1991

Type of Hearing Loss	Caucasian		African American		Asian American		Spanish American		Native American		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Conductive	226	4.8	21	.4	5	.1	52	1.1	23	.5	3	.1	330	7.0
Sensorineural	2914	61.5	602	12.7	33	.7	358	7.6	67	1.4	48	1.0	4022	84.9
Mixed	277	5.9	49	1.0	2	.0	37	.8	13	.3	5	.1	383	8.1
Overall	3417	72.2	672	14.2	40	.8	447	9.4	103	2.2	56	1.2	4735	100.0

Note: Cramer's V = .09. Total children possible = 5,178.

Severity of Hearing Loss

Because program effectiveness may be related to the severity of the children's hearing loss, the children's unaided hearing thresholds were reported by participating site personnel. The parent advisors were instructed to report the hearing sensitivity of the child in numerical dB values, using the child's best ear. These values were then converted to severity levels: no loss (< 25 dB); mild (25 - 40 dB); moderate (45 - 60 dB); severe (65 - 90 dB); and profound (> 90 dB). Generally, those children categorized as having "No Loss" were those with fluctuating, conductive hearing losses. Hearing-threshold data were not reported for 14% of the children.

The mean unaided severity level was 74 dB (sd = 25.4). The median severity level was 75 dB, which indicates that 50% of the children had hearing losses in the severe-to-profound range. Inspection of Table 16 indicates that 65% of the children had hearing losses in the moderate-through-severe range, as compared to the 42% reported by Gallaudet (see Table 1). While 23% of the children were reported as having profound hearing losses--compared to 38% reported by Gallaudet--only 12% were reported as having no loss or a mild loss, compared to the 18% reported by Gallaudet.

Across the program-start years, only small changes in the relative proportions were obtained (Table 17). The low Cramer's V (.11) reflects small increases in the percentages of children with no loss for the 1989-90 and 1990-91 program years. This increase likely reflects the additional enrollment of children with conductive hearing losses, especially for the 1990-91 year, which was noted previously in this chapter.

Table 16

Frequencies and Percentages of Children by Severity of Unaided Hearing Loss, 1979-1991

Severity	N	%
No	166	3.7
Mild	388	8.7
Moderate	884	19.8
Severe	2005	45.0
Profound	1015	23.0
Total	4458	100.2

Note: Mean severity overall= 75 dB (sd = 25.4, median = 75, mode = 90). Total children possible = 5,178.

Table 17

Frequencies and Percentages of Children by Severity of Unaided Hearing Loss, Overall and by Program-Start Year

Program Year	No		Mild		Moderate		Severe		Profound		
	N	%	N	%	N	%	N	%	N	%	Total N
7-1-79 thru 6-30-80	-	-	2	5.9	-	-	23	67.6	9	26.5	34
7-1-80 thru 6-30-81	-	-	3	2.4	23	18.7	67	54.5	30	24.4	123
7-1-81 thru 6-30-82	3	.8	26	7.3	79	22.1	179	50.1	70	19.6	357
7-1-82 thru 6-30-83	3	.7	30	6.9	88	20.2	226	51.8	89	20.4	436
7-1-83 thru 6-30-84	12	3.7	32	9.8	66	20.2	142	43.4	75	22.9	327
7-1-84 thru 6-30-85	7	2.1	33	9.7	62	18.2	150	44.0	89	26.1	341
7-1-85 thru 6-30-86	9	2.6	30	8.7	63	18.2	164	47.4	80	23.1	346
7-1-86 thru 6-30-87	12	2.4	29	5.8	106	21.3	215	43.2	136	27.3	498
7-1-87 thru 6-30-88	12	2.4	48	9.6	112	22.4	193	38.7	134	26.9	499
7-1-88 thru 6-30-89	19	3.6	60	11.4	111	21.1	246	46.9	89	17.0	525
7-1-89 thru 6-30-90	35	6.4	55	10.1	96	17.7	230	42.4	127	23.4	543
7-1-90 thru 6-30-91	54	12.6	40	9.3	78	18.2	170	39.6	87	20.3	429
Overall	166	3.7	388	8.7	884	19.8	2005	45.0	1015	22.8	4458

Note: Total children possible = 5,178. Cramer's V = .11.

The relationship between severity of hearing loss and gender was practically nil (Cramer's V =.05), as was the relationship between severity of hearing loss and race (Cramer's V = .06), indicating that the proportions within the cells were similar to expected proportions based on the marginal totals (Tables 18 and 19).

Table 18

Frequencies and Percentages of Male and Female Children by Severity of Unaided Hearing Loss, 1979-1991

Category	Male		Female		Overall	
	N	%	N	%	N	%
No	104	2.4	60	1.4	164	3.7
Mild	226	5.2	154	3.5	380	8.7
Moderate	480	11.0	392	9.0	872	19.9
Severe	1063	24.3	902	20.6	1965	44.9
Profound	531	12.1	467	10.7	998	22.8
Overall	2404	54.9	1975	45.1	4379	100.0

Note: Cramer's V = .05. Total children possible = 5,178.

A low Cramer's V (.11) was obtained for the relationship between severity of hearing loss and presence of additional handicapping conditions (Table 20). A slightly smaller percentage of children with other handicapping conditions was obtained for the profound-hearing-loss category than would be expected based on the marginal proportions.

Finally, a small to moderate Cramer's V (.38) was obtained for the relationship between severity of hearing loss and type of hearing loss (Table 21). That value reflects primarily greater frequencies of children with conductive hearing loss that were greater than expected based on the marginal totals for the No Loss and Mild severity levels and fewer children with conductive hearing loss than expected for the Severe and Profound levels based on the marginal totals. The finding was anticipated.

Table 19

Frequencies and Percentages of Children by Ethnicity and Severity of Unaided Hearing Loss, 1979-1991

Severity	Caucasian		African American		Asian American		Spanish American		Native American		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
No	124	2.8	12	.3	2	.0	17	.4	7	.2	2	.0	164	3.7
Mild	313	7.1	37	.8	0	.0	27	.6	6	.1	2	.0	385	8.8
Moderate	663	15.1	107	2.4	8	.2	69	1.6	15	.3	8	.2	870	19.8
Severe	1395	31.8	292	6.7	20	.5	202	4.6	36	.8	22	.5	1967	44.9
Profound	666	15.2	174	4.0	10	.2	119	2.7	14	.3	14	.3	997	22.7
Overall	3161	72.1	622	14.2	40	.9	434	9.9	78	1.8	48	1.1	4383	100.0

Note: Cramer's V = .06. Total children possible = 5,178.

Table 20

Frequencies and Percentages of Children with the Presence of Another Handicap by Severity of Unaided Hearing Loss, 1979-1991

Category	Other Handicap		No Other Handicap		Overall	
	N	%	*N*	%	*N*	%
No	50	1.2	115	2.6	165	3.8
Mild	134	3.1	245	5.6	379	8.7
Moderate	223	5.1	631	14.5	854	19.7
Severe	439	10.1	1514	34.8	1953	44.9
Profound	188	4.3	807	18.6	995	22.9
Overall	1034	23.8	3312	76.2	4346	100.0

Note: Cramer's *V* = .11. Total children possible = 5,178.

Table 21

Frequencies and Percentages of Children by Type of Hearing Loss and Severity of Hearing Loss, 1979-1991

Severity	Conductive		Sensorineural		Mixed		Total	
	N	%	*N*	%	*N*	%	*N*	%
No	97	2.3	41	1.0	17	.4	155	3.7
Mild	75	1.8	222	5.3	63	1.5	360	8.5
Moderate	60	1.4	673	15.9	103	2.4	836	19.8
Severe	32	.8	1746	41.3	133	3.1	1911	45.2
Profound	6	.1	928	22.0	31	.7	965	22.8
Overall	270	6.4	3610	85.4	347	8.2	4227	100.0

Note: Cramer's *V* = .38. Total children possible = 5,178.

Cause of Hearing Loss

For 46.9% (N = 2431) of the children, the cause of hearing loss was reported as unknown, and for an additional 2.8% (N = 144) of the children, the cause of loss was not reported at all (Table 22). The combined percentage (49.7%) is consistent with the value reported by Gallaudet for unknown and not reported causes of hearing loss (51.8%, see Table 1).

Of the known causes of hearing loss, meningitis was reported most frequently (12.2%), with heredity accounting for 10% of the hearing losses. For the total population of children (including the children whose cause of loss was reported as unknown or was not reported at all), approximately 20% of the hearing losses occurred after birth from such causes as meningitis, middle-ear problems, fever or infection in the child, drugs administered to the child, or other causes such as accidents. Comparison data from Gallaudet are provided in Table 1. However, comparisons should be made with caution, given that Gallaudet's report includes data for children and youth beginning at birth through 18 years of age.

A low Cramer's V (.10) reflects consistency in the relative proportions for each cause of hearing loss across the program years based on the marginal totals (Table 23). A few exceptions should be noted: (a) For the 1980-81 and 1981-82 program years, the frequency of children with hearing loss due to rubella or cytomegalovirus was more than twice the expectation based on the marginal totals; (b) for 1983-84 program year, the frequency of children with hearing loss due to fever or infection was nearly triple the expectation; (c) for the 1981-82 program year, the frequency of children with hearing loss due to drugs during pregnancy was nearly four times the expectation; (d) for the 1990-91 program year, the frequency of children with hearing loss due to middle-ear problems was two to three times the expectation; and (e) for the 1981-82 program year, the frequency of children with hearing loss due to birth trauma was twice the expectation.

Table 22

Frequencies and Percentages of Children by Cause of Hearing Loss, 1979-1991

Cause	N	%
Unknown	2431	46.9
Meningitis	631	12.2
Heredity	516	10.0
Middle-Ear Problems	251	4.8
Defects at Birth	234	4.5
Rubella/CMV	164	3.2
Conditions During Pregnancy	149	2.9
Birth Trauma	138	2.7
Child Syndrome	138	2.7
Fever or Infection in Child	130	2.5
Drugs Given to Child	44	.8
RH Incompatibility or Kernicterus	32	.6
Drugs During Pregnancy	26	.5
Other	150	2.9
Not Reported	144	2.8
Total	5178	100.0

Note: Total children possible = 5,178.

Table 23

Frequencies and Percentages of Children by Cause of Hearing Loss, Overall and by Program-Start Year

Program Year	Unknown		Heredity		Rubella CMV		Meningitis		Defects at Birth		Fever or Infections in Child		RH Incompatibility or Kernicterus		Drugs During Pregnancy		Premature		Middle Ear		Drugs Given to Child		Birth Trauma		Child Syndrome		Other		Total N
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	
7-1-79 thru 6-30-80	17	44.7	6	15.8	2	5.3	3	7.9	1	2.6	-	-	1	2.6	-	-	-	-	2	5.3	-	-	1	2.6	1	2.6	4	10.5	38
7-1-80 thru 6-30-81	68	49.6	11	8.0	10	7.3	20	14.6	6	4.4	3	2.2	1	.7	1	.7	6	4.4	2	1.5	-	-	2	1.5	-	-	7	5.1	137
7-1-81 thru 6-30-82	146	35.5	46	11.2	29	7.1	57	13.9	22	5.4	8	1.9	4	1.0	8	1.9	12	2.9	10	2.4	3	.7	27	6.6	10	2.4	29	7.1	411
7-1-82 thru 6-30-83	305	51.1	57	9.4	16	2.6	88	14.4	20	3.3	14	2.3	3	.5	3	.5	17	2.8	15	2.5	5	.8	19	3.1	11	1.8	36	5.9	609
7-1-83 thru 6-30-84	233	52.0	45	10.0	4	.9	48	10.7	20	4.5	31	7.1	2	.4	-	-	11	2.5	14	3.1	2	.4	10	2.2	9	2.0	18	4.0	448
7-1-84 thru 6-30-85	207	48.4	42	9.8	9	2.1	57	13.3	33	7.7	14	3.3	5	1.2	1	.2	8	1.9	15	3.5	2	.5	18	4.2	10	2.3	7	1.6	428
7-1-85 thru 6-30-86	207	53.9	29	7.6	13	3.4	57	14.8	15	3.9	9	2.3	-	-	2	.5	11	2.9	11	2.9	1	.3	6	1.6	20	5.2	3	.8	384
7-1-86 thru 6-30-87	279	51.2	56	10.3	22	4.0	69	12.7	20	3.7	18	3.3	7	1.3	3	.6	20	3.7	17	3.1	2	.4	9	1.7	21	3.9	2	.4	545
7-1-87 thru 6-30-88	263	48.9	71	13.2	11	2.0	71	13.2	22	4.1	13	2.4	7	1.3	2	.4	12	2.2	23	4.3	5	.9	17	3.2	20	3.7	1	.2	538
7-1-88 thru 6-30-89	303	54.9	51	9.2	15	2.7	64	11.6	27	4.9	10	1.8	2	.4	3	.5	16	2.9	33	6.0	8	1.4	7	1.3	11	2.0	2	.4	552
7-1-89 thru 6-30-90	294	50.9	62	10.7	18	3.1	59	10.2	30	5.2	3	.5	3	.5	3	.5	17	2.9	43	7.4	10	1.7	13	2.2	20	3.5	3	.5	578
7-1-90 thru 6-30-91	258	50.6	41	8.0	17	3.3	39	7.6	30	5.9	8	1.6	-	-	-	-	22	4.3	68	13.3	7	1.4	10	2.0	9	1.8	1	.2	510
Overall	2580	49.8	517	10.0	166	3.2	632	12.2	246	4.8	132	2.5	35	.7	26	.5	152	2.9	253	4.9	45	.9	139	2.7	142	2.7	113	2.2	5178

Note: Total children possible = 5,178. Cramer's V = ..10.

The relationship between cause of hearing loss and gender was extremely small (Cramer's $\underline{V}$ = .07), as was the relationship between cause of hearing loss and ethnicity (Cramer's $\underline{V}$ = .09). These small coefficients indicate that the frequencies within the cells were similar to expected frequencies based on the marginal totals (Tables 24 and 25).

A small Cramer's $\underline{V}$ (.34) was obtained for the relationship between cause of hearing loss and presence of additional handicapping conditions (Table 26). Inspection of the obtained cell values indicates that the frequencies of children with an additional handicapping condition and a birth defect or a child syndrome were larger than expected based on the marginal totals--a finding that was not surprising. Also anticipated was the finding that the obtained cell values for children with an additional handicapping condition and heredity or meningitis were smaller than expected based on the marginal totals.

The relatively large percentages of children whose hearing losses were caused by middle-ear problems or by birth defects (e.g., atresia) and who had conductive hearing losses contributed to the moderate Cramer's $\underline{V}$ (.45) that was obtained for the relationship between cause of loss and type of loss (Table 27). Similarly, the small Cramer's $\underline{V}$ (.23) obtained for the relationship between cause of loss and severity of loss (Table 28) reflects greater than expected frequencies of children whose hearing loss was caused by middle-ear problems or by birth defects and who had no loss to mild loss.

Table 24

Frequencies and Percentages of Children by Gender and Cause of Hearing Loss, 1979-1991

Cause	Male		Female		Total	
	N	%	N	%	N	%
Unknown	1252	24.8	1106	21.9	2358	46.7
Heredity	272	5.4	228	4.5	500	9.9
Rubella, CMV	86	1.7	79	1.6	165	3.3
Meningitis	382	7.6	238	4.7	620	12.3
Birth Defects	126	2.5	118	2.3	244	4.8
Fever/Infections in Child	77	1.5	54	1.1	131	2.6
RH or Kernicterus	18	.4	17	.3	35	.7
Drugs During Pregnancy	17	.3	9	.2	26	.5
Other Conditions During Pregnancy	89	1.8	62	1.2	151	3.0
Middle-Ear Problems	152	3.0	99	2.0	251	5.0
Drugs Given to Child	25	.5	19	.4	44	.9
Birth Trauma	77	1.5	61	1.2	138	2.7
Syndrome	69	1.4	73	1.4	142	2.8
Other	65	1.3	48	1.0	113	2.2
Not Reported	65	1.3	65	1.3	130	2.6
Overall	2772	54.9	2276	45.1	5048	100.0

Note: Cramer's V = .07. Total children possible = 5,178.

Table 25

Frequencies and Percentages of Children by Ethnicity and Cause of Hearing Loss, 1979-1991

Cause	Caucasian		African American		Asian American		Spanish American		Native American		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Unknown	1684	33.5	347	6.9	35	.7	226	4.5	32	.6	31	.6	2355	46.9
Heredity	393	7.8	59	1.2	0	.0	48	1.0	5	.1	5	.1	510	10.1
Rubella, CMV	114	2.3	28	.6	1	.0	13	.3	2	.0	5	.1	163	3.2
Meningitis	408	8.1	133	2.6	2	.0	51	1.0	18	.4	7	.1	619	12.3
Birth Defects	181	3.6	29	.6	2	.0	23	.5	6	.1	2	.0	243	4.8
Fever/Infections in Child	99	2.0	13	.3	1	.0	11	.2	3	.1	3	.1	130	2.6
RH or Kernicterus	26	.5	5	.1	0	.0	4	.1	0	.0	0	.0	35	.7
Drugs During Pregnancy	12	.2	9	.2	0	.0	1	.0	2	.0	1	.0	25	.5
Other Conditions During Pregnancy	110	2.2	25	.5	0	.0	13	.3	3	.1	1	.0	152	3.0
Middle-Ear Problems	174	3.5	14	.3	3	.1	37	.7	20	.4	1	.0	249	5.0
Drugs Given to Child	40	.8	4	.1	0	.0	1	.0	0	.0	0	.0	45	.9
Birth Trauma	111	2.2	12	.2	0	.0	10	.2	2	.0	0	.0	135	2.7
Child Syndrome	104	2.1	14	.3	2	.0	14	.3	4	.1	2	.0	140	2.8
Other	86	1.7	11	.2	0	.0	6	.1	8	.2	0	.0	111	2.2
Not Reported	74	1.5	23	.5	0	.0	12	.2	4	.1	0	.0	113	2.2
Overall	3616	72.0	726	14.4	46	.9	470	9.4	109	2.2	58	1.2	5025	100.0

Note: Cramer's V = .09. Total children possible = 5,178.

Table 26

Frequencies and Percentages of Children by Presence of Another Handicap and Cause of Hearing Loss, 1979-1991

Cause	Other Handicap		No Other Handicap		Total	
	N	%	N	%	N	%
Unknown	430	8.6	1916	38.5	2346	47.2
Heredity	47	.9	458	9.2	505	10.2
Rubella, CMV	75	1.5	83	1.7	158	3.2
Meningitis	113	2.3	510	10.3	622	12.5
Birth Defects	142	2.9	98	2.0	240	4.8
Fever/Infections in Child	23	.5	105	2.1	128	2.6
RH or Kernicterus	10	.2	25	.5	35	.7
Drugs During Pregnancy	9	.2	12	.2	21	.4
Other Conditions During Pregnancy	62	1.2	83	1.7	145	2.9
Middle-Ear Problems	80	1.6	167	3.4	247	5.0
Drugs Given to Child	9	.2	36	.7	45	.9
Birth Trauma	46	.9	73	1.5	119	2.4
Child Syndrome	100	2.0	39	.8	139	2.8
Other	50	1.0	58	1.2	108	2.2
Not Reported	31	.6	84	1.7	115	2.3
Overall	1227	24.7	3747	75.3	4974	100.0

Note: Cramer's V = .34. Total children possible = 5,178.

Table 27

Frequencies and Percentages of Children by Type of Hearing Loss and Cause of Child's Hearing Loss, 1979-1991

Cause	Conductive		Sensorineural		Mixed		Total	
	N	%	N	%	N	%	N	%
Unknown/No Resp.	46	1.0	2037	42.4	161	3.3	2244	46.7
Heredity	1	.0	474	9.9	22	.5	497	10.3
Rubella, CMV	3	.1	147	3.1	8	.2	158	3.3
Meningitis	1	.0	574	11.9	30	.6	605	12.6
Birth Defects	47	1.0	145	3.0	42	.9	234	4.9
Fever/Infections in Child	27	.6	81	1.7	12	.2	120	2.5
RH or Kernicterus	0	.0	29	.6	5	.1	34	.7
Drugs During Pregnancy	2	.0	20	.4	2	.0	24	.5
Other Conditions During Pregnancy	2	.0	134	2.8	8	.2	144	3.0
Middle-Ear Problems	166	3.5	36	.7	44	.9	246	5.1
Drugs Given to Child	0	.0	42	.9	1	.0	43	.9
Birth Trauma	4	.1	119	2.5	10	.2	133	2.8
Child Syndrome	20	.4	84	1.7	32	.7	136	2.8
Other	9	.2	74	1.5	7	.1	90	1.9
Not Reported	5	.1	85	1.8	9	.2	99	2.1
Overall	333	6.9	4081	84.9	393	8.2	4807	100.0

Note: Cramer's V = .45. Total children possible = 5,178.

Table 28

Frequencies and Percentages of Children by Severity and Cause of Hearing Loss, 1979-1991

Cause	No		Mild		Moderate		Severe		Profound		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Unknown	39	.9	140	3.1	381	8.5	1021	22.9	524	11.8	2105	47.2
Heredity	5	.1	42	.9	118	2.6	196	4.4	101	2.3	462	10.4
Rubella, CMV	6	.1	9	.2	22	.5	73	1.6	36	.8	146	3.3
Meningitis	11	.2	25	.6	77	1.7	258	5.8	178	4.0	549	12.3
Birth Defects	8	.2	35	.8	50	1.1	82	1.8	30	.7	205	4.6
Fever/Infections in Child	10	.2	16	.4	23	.5	44	1.0	20	.4	113	2.5
RH or Kernicterus	1	.0	1	.0	7	.2	16	.4	8	.2	33	.7
Drugs During Pregnancy	0	.0	2	.0	7	.2	9	.2	5	.1	23	.5
Other Conditions During Pregnancy	2	.0	14	.3	34	.8	65	1.5	26	.6	141	3.2
Middle-Ear Problems	76	1.7	55	1.2	35	.8	33	.7	5	.1	204	4.6
Drugs Given to Child	1	.0	4	.1	12	.3	18	.4	8	.2	43	1.0
Birth Trauma	1	.0	11	.2	33	.7	57	1.3	22	.5	124	2.8
Child Syndrome	1	.0	14	.3	36	.8	59	1.3	16	.4	126	2.8
Other	0	.0	12	.3	24	.5	32	.7	13	.3	81	1.8
Not Reported	5	.1	8	.2	25	.6	42	.9	23	.5	103	2.3
Overall	166	3.7	388	8.7	884	19.8	2005	45.0	1015	22.8	4458	100.0

Note: Cramer's *V* = .23. Total children possible = 5,178.

Age at Onset of Hearing Loss

Table 29 illustrates the distribution of students according to age at onset of hearing loss. Comparison data (provided here) were available from Ries and Voneiff (1974). For the majority of the children (70.1%) for whom this information was reported, the onset of hearing loss was at birth, with age at onset for 96.2% of the children under two years of age. Elssmann et al. (1987) reported a slightly higher percentage (79%) of children who had been born with hearing loss as compared to the SKI*HI data (71.8).

Table 29

Age at Onset of Hearing Loss, 1979-1991

Age at Onset	SKI*HI N	SKI*HI %	Ries & Voneiff N	Ries & Voneiff %
At Birth	1544	71.8	40,200	74.4
Under 1 Year	309	14.4	3,788	7.0
1 Year to 2 Years	214	10.0	3,781	7.0
2 Years to 3 years	63	2.9	2,377	4.4
3 Years and Over	19	.9	3,854	7.1
Total	2149	100.0	54,000	100.0

Note: Total possible children for SKI*HI = 5,178.

Age-at-onset information was not reported for 58% of the children. However, as mentioned in the previous section of this report, for nearly 50% of the children, the cause of hearing loss was unknown or not reported. As we will report in the next chapter, 50% of the children were identified as hearing impaired by 17 months of age, with approximately 75% of the children identified by 24 months of age. Therefore, it is a reasonable assumption that for the majority of the 5,178 children, including the 50% for whom the cause of loss was unknown, the age at onset was prior 24 months--a significant finding for those responsible for language, communication, cognition, and literacy programming. More importantly, however, this finding reinforces the argument that children with hearing impairments must be identified at the earliest possible age so that programming for language, communication, cognition, and emergent literacy development can begin early. Identification age and identification procedures will be the subject of the chapter that follows.

Across the program-start years, only small changes in the relative proportions were obtained (Table 30). The low Cramer's V (.07) reflects only slight changes in the percentages of children across the program-start years.

A low Cramer's V (.09) was obtained for the relationship between age at onset and severity of hearing loss (Table 31). A slightly greater percentage of children with profound losses was obtained for age at onset between one to two years than would be expected based on the marginal proportions.

Although tables are not provided here, additional two-way frequency analyses were conducted for age at onset. Those findings are reported here. The association between age at onset and gender was small (Cramer's V = .06). The association between age at onset and ethnicity was also small (Cramer's V = .08). The association between age at onset and presence of additional handicaps was low (Cramer's V = .18); slightly greater percentages of children without additional handicaps were obtained for age at onset after two years of age than would be expected based on the marginal totals. The association between age at onset and type of hearing loss was small (Cramer's V = .05).

The association between age at onset and cause of hearing loss was moderate (Cramer's V = .46). For age at onset at birth, smaller percentages of children whose cause of hearing loss was meningitis were obtained than would be expected based on the marginal totals. For age at onset after birth, smaller percentages of children whose cause of hearing loss was heredity, rubella or other congenital infections, defects at birth, Rh incompatibility, drugs during pregnancy, conditions during pregnancy, or a syndrome were obtained than would be expected based on the marginal totals. Neither of these findings were surprising.

Table 30

Frequencies and Percentages of Children by Age at Onset of Hearing Loss, Overall and by Program-Start Year

School Year	At Birth		Birth to 1 Year		1 to 2 Years		2 to 3 Years		3 Years & Older		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
7-1-79 thru 6-30-80	15	83.3	–	–	3	16.7	–	–	–	–	18	.8
7-1-80 thru 6-30-81	40	74.1	8	14.8	5	9.3	1	1.9	–	–	54	2.5
7-1-81 thru 6-30-82	168	77.4	29	13.4	14	6.5	4	1.8	2	.9	217	10.1
7-1-82 thru 6-30-83	175	68.4	35	13.7	33	12.9	10	3.9	3	1.2	256	11.9
7-1-83 thru 6-30-84	120	67.0	31	17.3	19	10.6	7	3.9	2	1.1	179	8.3
7-1-84 thru 6-30-85	134	74.4	19	10.6	22	12.2	3	1.7	2	1.1	180	8.4
7-1-85 thru 6-30-86	98	67.1	27	18.5	17	11.6	4	2.7	–	–	146	6.8
7-1-86 thru 6-30-87	160	69.0	29	12.5	31	13.4	11	4.7	1	.4	232	10.8
7-1-87 thru 6-30-88	171	72.2	38	16.0	18	7.6	9	3.8	1	.4	237	11.0
7-1-88 thru 6-30-89	139	69.8	29	14.6	21	10.6	6	3.0	4	2.0	199	9.3
7-1-89 thru 6-30-90	180	76.3	33	14.0	17	7.2	4	1.7	2	.8	236	11.0
7-1-90 thru 6-30-91	144	73.8	31	15.9	14	7.2	4	2.1	2	1.0	195	9.1
Overall	1544	71.8	309	14.4	214	10.0	63	2.9	19	.9	2149	100.0

Note: Cramer's V = .07.

Table 31

Frequencies and Percentages of Children by Severity of Hearing Loss and Age at Onset of Hearing Loss, 1979-1991

Age at Onset	No		Mild		Moderate		Severe		Profound		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
At Birth	26	1.4	138	7.3	324	17.1	604	31.9	266	14.1	1358	71.7
Birth to 1 Year	15	.8	15	.8	45	2.4	129	6.8	73	3.9	277	14.6
1 to 2 Years	1	.1	10	.5	27	1.4	85	4.5	64	3.4	187	9.9
2 to 3 Years	1	.1	6	.3	6	.3	25	1.3	15	.8	53	2.8
3 to 6 Years	0	0	1	.1	3	.2	9	.5	5	.3	18	1.0
Overall	43	2.3	170	9.0	405	21.4	852	45.0	423	22.3	1893	100.0

Note: Cramer's V = .09.

Family-Status Variables

Language Spoken in the Home

Parent advisors reported what primary language was spoken in the child's home from among the following choices: English, Spanish, American Sign Language (ASL), a signed English system, or other. Ninety percent of the children came from homes in which English was the primary language spoken (Table 32). Spanish was spoken in nearly 5% of the homes. ASL and/or a signed English system was used in 3.7% of the homes. And, other international languages (e.g., Korean) were spoken in 1.5% of the homes. For 2.7% of the children, the primary language spoken in the home was not reported.

Table 32

Frequencies and Percentages of Children by Language Spoken in the Home, 1979-1991

Language	N	%
English	4531	90.0
Spanish	243	4.8
ASL	135	2.7
Signed English	52	1.0
Other	76	1.5
Total	5037	100.0

Note: Total children possible = 5,178.

A low Cramer's V (.06) reflects only slight changes in the relative percentages across the program-start years (Table 33). Likewise, the relationship between language spoken in the home and severity of hearing loss (Table 34) was practically nil (Cramer's V = .05). The somewhat larger Cramer's V (.19) obtained for the relationship between language spoken in the home and cause of hearing loss (Table 35) reflects the larger-than-expected frequencies of children whose cause of hearing loss was heredity and who came from homes in which ASL was the primary language.

Table 33

Frequencies and Percentages of Children by Language Spoken in the Home, Overall and by Program-Start Year

Program Year	English		Spanish		ASL		Signed Eng. System		Other		Total N
	N	%	N	%	N	%	N	%	N	%	
7-1-79 thru 6-30-80	32	91.4	-	-	1	2.9	2	5.7	-	-	35
7-1-80 thru 6-30-81	123	91.1	6	4.4	3	2.2	1	.7	2	1.5	135
7-1-81 thru 6-30-82	363	90.5	9	2.2	14	3.5	7	1.7	8	2.0	401
7-1-82 thru 6-30-83	510	87.2	36	6.2	26	4.4	4	.7	9	1.5	585
7-1-83 thru 6-30-84	387	91.1	18	4.2	8	1.9	6	1.4	6	1.4	425
7-1-84 thru 6-30-85	374	88.8	24	5.7	10	2.4	7	1.7	6	1.4	421
7-1-85 thru 6-30-86	325	91.3	19	5.3	8	2.2	3	.8	1	.3	356
7-1-86 thru 6-30-87	480	91.1	21	4.0	12	2.3	8	1.5	6	1.1	527
7-1-87 thru 6-30-88	484	91.8	22	4.2	12	2.3	1	.2	8	1.5	527
7-1-88 thru 6-30-89	501	91.8	30	5.5	5	.9	1	.2	9	1.6	546
7-1-89 thru 6-30-90	502	87.2	39	6.8	19	3.3	11	1.9	5	.9	576
7-1-90 thru 6-30-91	450	89.5	19	3.8	17	3.4	1	.2	16	3.2	503
Overall	4531	90.0	243	4.8	135	2.7	52	1.0	76	1.5	5037

Note: Total children possible = 5,178.
Cramer's V = .06.

Table 34

Frequencies and Percentages of Children by Language and Severity of Unaided Hearing Loss, 1979-1991

Severity	English		ASL		Spanish		Signed English		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
No	156	3.6	1	.0	6	.1	0	.0	3	.1	166	3.8
Mild	369	8.4	3	.1	9	.2	1	.0	3	.1	385	8.8
Moderate	798	18.3	20	.5	38	.9	5	.1	5	.1	866	19.8
Severe	1756	40.2	50	1.1	99	2.3	20	.5	33	.8	1958	44.8
Profound	860	19.7	43	1.0	57	1.3	18	.4	18	.4	996	22.8
Overall	3939	90.1	117	2.7	209	4.8	44	1.0	62	1.4	4371	100.0

Note: Cramer's V = .05. Total children possible = 5,178.

Table 35

Frequencies and Percentages of Children by Home Language and Cause of Hearing Loss, 1979-1991

Cause	English		ASL		Spanish		Signed English		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Unknown	2173	43.1	20	.4	114	2.3	20	.4	36	.7	2363	46.9
Heredity	361	7.2	102	2.0	23	.5	15	.3	7	.1	508	10.1
Rubella, CMV	154	3.1	0	.0	5	.1	0	.0	3	.1	162	3.2
Meningitis	578	11.5	0	.0	31	.6	4	.1	10	.2	623	12.4
Birth Defects	221	4.4	1	.0	13	.3	1	.0	6	.1	242	4.8
Fever/Infections in Child	119	2.4	0	.0	9	.2	1	.0	2	.0	131	2.6
RH or Kernicterus	30	.6	1	.0	2	.0	1	.0	0	.0	34	.7
Drugs During Pregnancy	24	.5	0	.0	1	.0	0	.0	0	.0	25	.5
Other Conditions During Pregnancy	141	2.8	0	.0	5	.1	1	.0	1	.0	148	2.9
Middle-ear Problems	218	4.3	3	.1	21	.4	0	.0	9	.2	251	5.0
Drugs Given to Child	43	.8	0	.0	1	.0	1	.0	0	.0	45	.9
Birth Trauma	131	2.6	1	.0	3	.1	1	.0	0	.0	136	2.7
Child Syndrome	129	2.6	4	.1	5	.1	2	.0	1	.0	141	2.8
Other	102	2.0	3	.1	5	.1	2	.0	0	.0	112	2.2
Not Reported	107	2.1	0	.0	5	.1	3	.1	1	.0	116	2.3
Overall	4531	90.0	135	2.7	243	4.8	52	1.0	76	1.5	5037	100.0

Note: Cramer's V = .19. Total children possible = 5,178.

Although tables are not provided here, additional two-way frequency analyses were conducted for language spoken in the home. Those findings are reported here. The associations between language spoken in the home and gender, and presence of other handicaps, and type of hearing loss, and age at onset were all small (Cramer's V = .02, .06, .05, .09, respectively). The association between language spoken in the home and ethnicity was low (Cramer's V = .37), reflecting anticipated findings. That is, Spanish tended to be the language spoken in the homes of children who were Spanish-American.

Hearing-Impaired Parent(s)

Nine percent of the children came from families in which one or both parents were hearing impaired (Table 36). This value is consistent with that mentioned previously (i.e., for 10% of the children, the known cause of hearing loss had been identified as heredity). A small Cramer's V (.11) reflects some changes in the relative percentages across the program-start years (Table 37). Most noticeably, for the 1981-82 program year, nearly 16% of the children came from families in which one or both parents had a hearing loss. The presence/absence of parental hearing loss was not reported for 3.4% of the children.

Table 36

Frequencies and Percentages of Children by Presence of Hearing-Impaired Parent, 1979-1991

Type	N	%
One or More HI Parent	448	9.0
No HI Parent	4552	91.0
Total	5000	100.0

Note: Total children possible = 5,178.

Extremely small Cramer's Vs indicate little relationship between parental hearing loss and gender (V = .01, Table 38), parental hearing loss and ethnicity (V = .04, Table 39), parental hearing loss and presence of another handicapping condition (V = .07, Table 40), parental hearing loss and type of loss (V = .05, Table 41), and parental hearing loss and severity of loss (V = .05, Table 42). That is, for all relationships, the obtained cell values were proportional to what would be expected based on the marginal values.

A moderate Cramer's V (.56) for parental hearing loss and cause of loss reflects the larger-than-expected frequencies based on the marginal values, of children with a hearing-impaired parent and for whom heredity was the cause of loss (Table 43)--an anticipated finding. Similarly, the moderate Cramer's V (.44) for parental hearing loss and language spoken in the home reflects the larger-than-expected frequencies of children with a hearing-impaired parent whose primary language spoken in the home was ASL (Table 44)--another anticipated finding. It should be pointed out, however, that although nearly 9% of the children had at least one hearing-impaired parent, for only 2.7% of the children was ASL used in the home and for only 1% of the children was signed English used. It can be concluded that for 5.2% of the children with a hearing-impaired parent, the families do not use ASL or signed English as the primary language of the home with their hearing-impaired child.

Although the table is not provided here, an additional two-way frequency analysis was conducted for presence of parental hearing loss and age at onset. A low Cramer's V (.24) reflected an anticipated outcome; a larger percentage of children whose age at onset was at birth had a hearing-impaired parent than would be expected based on the marginal totals.

Table 37

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent, Overall and by Program-Start Year

Program Year	At Least One Parent Hearing Impaired		Neither Parent Hearing Impaired		Total N
	N	%	N	%	
7-1-79 thru 6-30-80	7	20.0	28	80.0	35
7-1-80 thru 6-30-81	14	10.6	118	89.4	132
7-1-81 thru 6-30-82	62	15.9	329	84.1	391
7-1-82 thru 6-30-83	64	11.1	515	88.9	579
7-1-83 thru 6-30-84	55	13.3	358	86.7	413
7-1-84 thru 6-30-85	36	8.7	380	91.3	416
7-1-85 thru 6-30-86	22	6.0	342	94.0	364
7-1-86 thru 6-30-87	36	6.8	493	93.2	529
7-1-87 thru 6-30-88	33	6.3	494	93.7	527
7-1-88 thru 6-30-89	33	6.1	511	93.9	544
7-1-89 thru 6-30-90	45	7.9	528	92.1	573
7-1-90 thru 6-30-91	41	8.2	456	91.8	497
Overall	448	9.0	4552	91.0	5000

Note: Total children possible = 5,178. Cramer's V = .11.

Table 38

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent by Child's Gender, 1979-1991

Gender	At Least One Parent Hearing Impaired N	At Least One Parent Hearing Impaired %	Neither Parent Hearing Impaired N	Neither Parent Hearing Impaired %	Total N	Total %
Male	247	5.0	2462	49.9	2709	54.9
Female	187	3.8	2036	41.3	2223	45.1
Total	434	8.8	4498	91.2	4932	100.0

Note: Cramer's V = .01. Total children possible = 5,178.

Table 39

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent by Child's Ethnicity, 1979-1991

Ethnicity	At Least One Parent Hearing Impaired N	At Least One Parent Hearing Impaired %	Neither Parent Hearing Impaired N	Neither Parent Hearing Impaired %	Total N	Total %
Caucasian	333	6.8	3219	65.3	3552	72.1
African American	59	1.2	648	13.2	707	14.3
Spanish American	35	.7	427	8.7	462	9.4
Native American	4	.1	102	2.1	106	2.2
Asian American	1	< 1	42	.9	43	.9
Other	8	.2	49	1.0	57	1.2
Total	440	8.9	4487	91.1	4927	100.0

Note: Cramer's V = .04. Total children possible = 5,178.

Table 40

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent by Presence of Other Handicaps, 1979-1991

Presence of Other Handicaps	At Least One Parent Hearing Impaired		Neither Parent Hearing Impaired		Total	
	N	%	N	%	N	%
Other Handicap Present	61	1.3	1133	23.2	1194	24.5
Other Handicap Not Present	366	7.5	3315	68.0	3681	75.5
Total	427	8.8	4448	91.2	4875	100.0

Note: Cramer's V = .07. Total children possible = 5,178.

Table 41

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent by Type of Hearing Loss, 1979-1991

Type of Loss	At Least One Parent Hearing Impaired		Neither Parent Hearing Impaired		Total	
	N	%	N	%	N	%
Conductive	13	.3	316	6.7	329	7.0
Sensorineural	373	7.9	3626	76.9	3999	84.9
Mixed	30	.6	355	7.5	385	8.2
Total	416	8.8	4297	91.2	4713	100.0

Note: Cramer's V = .05. Total children possible = 5,178.

Table 42

Frequencies and Percentages of Children with a Hearing-Impaired Parent by Severity of Unaided Hearing Loss, 1979-1991

Category	HI Parent		No HI Parent		Overall	
	N	%	N	%	N	%
No	9	.2	157	3.6	166	3.8
Mild	41	.9	341	7.8	382	8.8
Moderate	92	2.1	773	17.7	865	19.8
Severe	158	3.6	1797	41.2	1955	44.8
Profound	76	1.7	916	21.0	992	22.8
Overall	376	8.6	3984	91.4	4360	100.0

Note: Cramer's V = .05. Total children possible = 5,178.

Table 43

Frequencies and Percentages of Children With at Least One Hearing-Impaired Parent by Cause of Hearing Loss, 1979-1991

Cause	One or More HI Parents		No HI Parents		Total	
	N	%	N	%	N	%
Unknown	84	1.7	2237	44.7	2321	46.4
Heredity	288	5.8	225	4.5	513	10.3
Rubella, CMV	3	.1	160	3.2	163	3.3
Meningitis	14	.3	608	12.2	622	12.4
Birth Defects	5	.1	237	4.7	242	4.8
Fever/Infections in Child	3	.1	129	2.6	132	2.6
RH or Kernicterus	0	.0	34	.7	34	.7
Drugs During Pregnancy	0	.0	26	.5	26	.5
Other Conditions During Pregnancy	7	.1	143	2.9	150	3.0
Middle-ear Problems	10	.2	239	4.8	249	5.0
Drugs Given to Child	0	.0	45	.9	45	.9
Birth Trauma	3	.1	134	2.7	137	2.7
Child Syndrome	11	.2	128	2.6	139	2.8
Other	9	.2	104	2.1	113	2.3
Not Reported	11	.2	103	2.1	114	2.3
Overall	448	9.0	4552	91.0	5000	100.0

Note: Cramer's V = .56. Total children possible = 5,178.

Table 44

Frequencies and Percentages of Children with At Least One Hearing-Impaired Parent by Language Spoken in the Home

Language	At Least One Parent Hearing Impaired		Neither Parent Hearing Impaired		Total	
	N	%	N	%	N	%
English	285	5.8	4155	84.2	4440	90
Spanish	20	.4	218	4.4	238	4.8
ASL	108	2.2	24	.5	132	2.7
Signed English	17	.3	33	.7	50	1
Other	7	.1	66	1.3	73	1.5
Total	437	8.9	4496	91.1	4933	100

Note: Cramer's V = .44. Total children possible = 5,178.

Relationship Between Demographic Variables and Pretest Receptive and Expressive Language Quotients

In addition to describing the demographic characteristics of the children, one objective was to determine the relationship between each of the demographic variables and pretest expressive and receptive language quotients. The pretest quotients were calculated by dividing the child's pretest score (in months) on the Language Development Scale (LDS) by the child's pretest age (in months) and multiplying by 100. A quotient of 100 indicates that the child's language age and the child's chronological age are equal. On the other hand, a quotient of 50 indicates that the child's language age was half that of his/her chronological age. Overall, the mean pretest expressive language quotient was 56; the mean pretest receptive language quotient was 60.

One-way analyses of variance were conducted. In each analysis, the demographic variable was the independent variable and the quotient was the dependent variable. Additionally, for those analyses that resulted in a statistically significant F value, the Tukey multiple-comparison technique was used to determine which differences between pairs of means were statistically significant.

Given the large sample size for this study, it was anticipated that nearly all statistical analyses would result in statistically significant differences among or between means. For differences determined to be statistically significant, it was important to determine the magnitude of those differences, for with large samples, even small and unimportant differences between means may be statistically significant (Shaver, 1985a, 1985b, 1992). Therefore, correlation ratios (Eta^2) were calculated (the between-groups sums of squares was divided by the total sums of squares from the analyses of variance) as an estimate of effect size (the proportion of variability in the quotients that was associated with group membership for each demographic variable). Additionally, standardized mean differences (SMDs) were calculated to estimate the practical significance of the difference between the means, using Cohen's (1988) standards, provided in Chapter 4. In every instance, the smallest mean was subtracted from the largest mean and divided by the overall standard deviation for the expressive or receptive quotients (sds = 29.1 and 30.5, respectively). The findings from these analyses are summarized below and in Table 45.

Table 45

Relationship Between Demographic Variables and Pretest Receptive and Expressive Language Quotients

	Expressive Quotient					Receptive Quotient				
Variable	M	(sd)	n	F	Eta^2	M	(sd)	n	F	Eta^2
Gender										
Male	54.8	(28.8)	1745	2.2	<.01	59.5	(31.0)	1747	.8	<.01
Female	56.4	(29.3)	1460			60.5	(30.0)	1463		
Ethnicity										
Caucasian	58.9	(29.4)	2360	24.2*	.04	63.2	(30.9)	2364	20.6*	.03
African American	44.9	(26.1)	463			49.5	(28.7)	464		
Spanish American	48.1	(25.8)	285			53.6	(26.5)	286		
Native American	53.2	(26.0)	46			57.9	(26.8)	45		
Asian American	46.6	(34.6)	30			47.2	(29.3)	30		
Other	49.1	(26.9)	35			55.0	(28.2)	35		
Other Handicap										
Yes	48.8	(30.0)	736	53.2*	.02	53.5	(31.2)	741	45.2*	.01
No	57.7	(28.5)	2443			62.1	(30.1)	2443		
Type of Hearing Loss										
Conductive	65.0	(29.3)	188	10.1*	.01	75.5	(28.6)	188	26.7*	.02
Sensorineural	55.1	(28.6)	2664			59.0	(30.1)	2666		
Mixed	56.4	(32.7)	244			62.8	(33.5)	245		
Severity of Hearing Loss										
No Loss	62.4	(25.9)	101	24.2*	.03	73.1	(25.3)	101	30.2*	.04
Mild	66.6	(31.6)	245			72.9	(31.3)	246		
Moderate	61.1	(29.9)	599			64.7	(30.6)	601		
Severe	53.0	(27.9)	1351			56.9	(28.6)	1352		
Profound	50.6	(27.4)	681			54.9	(28.7)	682		
Cause of Hearing Loss										
Unknown/NR	52.7	(26.4)	1593	10.3*	.04	57.1	(28.1)	1593	10.9*	.04
Heredity	69.4	(34.8)	342			74.3	(38.8)	342		
Rubella/CMV	51.9	(27.0)	108			54.6	(27.7)	109		
Meningitis	56.1	(28.8)	402			59.8	(29.6)	403		
Defects @ Birth	56.4	(35.8)	154			62.9	(35.5)	154		
Fever or Infections	47.5	(25.5)	82			51.9	(28.8)	82		
RH Incompatibility	55.2	(20.0)	20			54.6	(19.1)	20		
Drugs During Pregnancy	54.7	(34.7)	19			60.2	(35.3)	19		
Conditions During Pregnancy	49.4	(24.1)	110			52.7	(23.7)	110		
Middle Ear	60.3	(27.0)	136			69.2	(26.6)	136		
Drugs Given to Child	61.5	(34.0)	31			59.3	(25.7)	31		
Birth Trauma	55.5	(29.5)	87			56.8	(30.2)	87		
Child Syndrome	63.9	(35.2)	91			68.0	(35.2)	94		

Table 45 (Continued)

	Expressive Quotient					Receptive Quotient				
Variable	*M*	(sd)	*n*	*F*	Eta^2	*M*	(sd)	*n*	*F*	Eta^2
Age at Onset										
At Birth	60.2	(33.2)	1000	3.0*	.01	64.5	(34.8)	1004	3.2*	.01
Under 1 Year	52.7	(28.7)	210			56.4	(27.8)	211		
1 Year to 2 Years	55.1	(27.5)	144			58.4	(29.2)	144		
2 Years to 3 Years	63.2	(31.9)	36			63.9	(33.9)	36		
3 Years and Over	60.4	(43.3)	8			65.6	(29.0)	8		
Language Spoken In the Home										
English	55.8	(29.0)	2903	13.4*	.02	60.0	(30.5)	2908	12.6*	.02
Spanish	43.0	(23.0)	137			48.3	(23.5)	137		
ASL	70.3	(33.6)	84			76.6	(34.3)	84		
Signed English	56.9	(30.1)	41			65.5	(31.2)	41		
Other	45.1	(29.1)	42			51.3	(30.0)	42		
Presence of Hearing-Impaired Parent										
Yes	67.1	(33.3)	274	48.3*	.01	72.2	(33.4)	274	49.5*	.02
No	54.4	(28.3)	2926			58.8	(30.0)	2931		

Note: * = Statistically significant difference between/among the mean quotients.
For SKI*HI overall, Expressive *M* = 55.5 (*sd* = 29.1, *Mdn* = 51.6); Receptive *M* = 59.9 (*sd* = 30.5, *Mdn* = 55.9).

Gender

No statistically significant differences were obtained between the mean pretest expressive and receptive quotients for males and females, and the Eta^2 values were practically nil (Table 45). The *SMD*s were small as well (.05 and .03, respectively).

Ethnicity

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for the ethnic groups, *F*(5, 3213) = 24.2, *p* <.05 and *F*(5, 3218) = 20.6, *p* <.05; however, the Eta^2 values were extremely small (.04 and .03, respectively), indicating little relationship between ethnicity and the magnitude of the expressive or receptive quotients. The small Eta^2 reflects in part the small numbers of Native-American children

(N = 46; 1%), Asian-American children (N = 30; 1%), and children of other ethnic minorities (N = 35, 1%). With 73% of the quotients in the Caucasian category, there was little variability in quotients by ethnic type.

The findings from Tukey's multiple-comparison technique indicated that for the expressive quotients, the differences between the mean for the Caucasian children and those for the African-American and the Spanish-American children were statistically significant. The SMDs for these pairs of means were small (.48 and .37, respectively) by Cohen's (1988) standards. For the receptive quotients, the differences between the mean for the Caucasian children and those for the Asian-American, the African-American, and the Spanish-American children were statistically significant, with moderate-to-small SMDs (.53, .45, and .32, respectively).

Other Handicap

Statistically significant differences were obtained between the mean pretest expressive and receptive quotients for children with an additional handicapping condition and children without, favoring those children without, $F(1, 3177) = 53.2$, $p < .05$ and $F(1, 3182) = 45.2$, $p < .05$. However, the Eta^2 values were again practically nil (Table 45), indicating little relationship between presence/absence of an additional handicapping condition and the magnitude of the quotients. The SMDs were low as well (.31 and .28, respectively).

Type of Hearing Loss

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for type of hearing loss, $F(2, 3093) = 10.1$, $p < .05$ and $F(2, 3096) = 26.7$, $p < .05$; however, the Eta^2 values were again extremely small (.01 and .02, respectively), indicating little relationship between type of hearing loss and the magnitude of the expressive or receptive quotients. For both the expressive and receptive quotients, children with conductive hearing losses obtained a statistically significantly higher mean score than children with sensorineural or mixed losses. The SMDs for the pairs of means ranged from small (.34) to medium (.54).

Severity of Hearing Loss

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for severity of hearing loss, $F(4, 2972) = 24.2$, $p < .05$ and $F(4, 2977) = 30.2$, $p < .05$; however, the Eta^2 values were again extremely small (.03 and .04, respectively), indicating little relationship between severity of hearing loss and the magnitude of the expressive or receptive quotients. For both the expressive and receptive quotients, children with no loss, mild losses, and moderate losses obtained statistically significantly higher mean pretest quotients than children with severe or profound hearing losses. The SMDs for the pairs of means ranged from small (.26) to medium (.60).

Cause of Hearing Loss

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for cause of hearing loss, $F(12, 3162) = 10.3$, $p < .05$ and $F(12, 3167) = 10.9$, $p < .05$; however, the Eta^2 values were again extremely small (.04 and .04, respectively), indicating little relationship between cause of hearing loss and the magnitude of the expressive or receptive quotients. For the expressive quotients, children whose hearing losses were caused by heredity or by a syndrome obtained the highest mean quotients. For the receptive quotients, children whose hearing losses were caused by heredity, middle-ear infections, or by a syndrome obtained the highest mean quotients. All SMDs for statistically significant comparisons were small to moderate (range = .36 to .76).

Age at Onset of Hearing Loss

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for age at onset of hearing loss, $F(4, 1393) = 3.0$, $p < .05$ and $F(4, 1398) = 3.2$, $p < .05$; however, the Eta^2 values were again practically nil (.01 and .01, respectively), indicating no relationship between age at onset of hearing loss and the magnitude of the expressive or receptive quotients. For the expressive and receptive quotients, children whose onset was at birth obtained a statistically significantly higher mean quotient than children whose onset was between birth and one year of age. However, the SMDs were small (.26 and .27, respectively).

Language Spoken in the Home

Statistically significant differences were obtained among the mean pretest expressive and receptive quotients for language spoken in the home, $F(4, 3202) = 13.4$, $p < .05$ and $F(4, 3207) = 12.6$, $p < .05$; however, the Eta^2 values were again extremely small (.02 and .02, respectively), indicating little relationship between language spoken in the home and the magnitude of the expressive or receptive quotients. For both the expressive and receptive quotients, children whose primary home language was ASL obtained a statistically significantly higher mean score than children whose home language was Spanish, English, or other. The SMDs for the pairs of means ranged from small (.38) to large (.94), favoring children whose primary home language was ASL.

Presence of Hearing-Impaired Parent

Statistically significant differences were obtained between the mean pretest expressive and receptive quotients for children with a hearing-impaired parent and children without, favoring those children with a hearing-impaired parent, $F(1, 3198) = 48.3$, $p < .05$ and $F(1, 3203) = 49.5$, $p < .05$. However, the Eta^2 values were again practically nil (.01 and .02, respectively), indicating little relationship between parental hearing loss and the magnitude of the quotients. The SMDs were low (.44 and .44, respectively) by Cohen's (1988) standards.

Summary of Relationships Between Demographic Variables and Language Quotients

In summary, the relationships between each of the demographic variables and pretest expressive and receptive language quotients were studied to determine the magnitude of the relationships. A summary of these findings follows:

1. Statistically significant differences between or among the pretest means were obtained for all demographic variables except gender.

Given the large sample sizes, it was not surprising that the mean differences were statistically significant.

2. Correlation ratios (Eta^2) which indicate the proportion of variability among the quotients that was associated with each of the demographic variables were small, leading to the conclusion that there was little relationship between pretest quotients and the demographic variables.

3. Standardized mean differences (SMDs), which indicate the magnitude of the differences between means and are independent of sample size (unlike indices of statistical significance), were small to medium for the most part. For example, the mean pretest quotients of children without additional handicaps were approximately 1/3 of standard deviation larger than the mean pretest quotients of children with additional handicaps. Although this difference was statistically significant, the difference between the means was very small from an educational perspective.

4. The only large SMDs were obtained for children whose home language was ASL as compared to children whose home language was Spanish, English, or other. The largest SMD (.94) described the difference between the mean pretest quotients of children whose home language was ASL and children whose home language was Spanish--a difference of nearly one full standard deviation. It should be noted that the standard deviations were largest for children whose home language was ASL, indicating greater variability among the pretest quotients than for the children whose home language was Spanish.

Summary

Although this chapter contains discussions of some comparisons of the SKI*HI data with Gallaudet University (1991) data, the primary purpose was to sketch the demographic characteristics of the children and their families. Data were provided for each demographic characteristic, overall and by program-start year. In addition, two-way frequency tables were used to illustrate potential relationships between variables. Finally, findings were presented describing the magnitude of the relationships between each demographic variable and pretest expressive and receptive language quotients. The intent was to set a context for the reporting of our analyses for the identification-procedure and the program-effectiveness portions of this study. Identification procedures are the subject of the next chapter.

CHAPTER 6

IDENTIFICATION PROCEDURES: THE RESULTS

A second general purpose of the investigation was to study the effectiveness of screening procedures (e.g., Crib-O-Gram, high-risk register, behavioral testing) for identifying hearing loss in neonates, infants, and young children. Effectiveness was defined as that procedure which results in the earliest mean identification age, program-start age, and hearing-aid-fit age, and the shortest time intervals between suspicion to identification, identification to program start, and suspicion to program start. Because identification-procedure information is not collected on the SKI*HI Data Sheet, a questionnaire was developed (see Chapter 4 and Appendix E) and was sent to site personnel who had agreed to participate in this additional data-collection effort. Information related to identification procedure, parental suspicion of hearing loss, and cause of suspicion was requested. Only children for whom data were submitted for the 1986-1989 program years were included in this portion of the study. Personnel from 65 sites (15 states) agreed to participate. Identification-procedure data were submitted for 1,404 children (Table 46).

To set the context for comparing mean ages and time intervals for the various identification procedures, we present first in this section the descriptive statistics for each of the ages (identification age, program-start age, and hearing-aid-fit age) and time-interval variables (interval between suspicion and identification, identification and program start, and suspicion and program start) for SKI*HI overall, both collectively and by program-start year. Because early identification of hearing loss is a decisive factor in children's language, communication, cognitive, social, and emergent-literacy development, identification age is a critical variable. Therefore, we also present data describing the relationship between each of the demographic variables discussed in Chapter 5 and identification age. Additionally, for analyses of demographic variables that resulted in statistically or educationally significant findings among the identification

Table 46

Frequencies and Percentages of Children by State for Those Sites Volunteering to Participate in Identification-Procedure Study, 1986-1989

State	N of Sites	N of Children	%
Arkansas	2	46	3.3
Florida	1	7	.5
Georgia	1	204	14.5
Indiana	1	26	1.9
Maine	1	3	.2
Michigan	9	22	1.6
Missouri	1	79	5.6
Mississippi	1	26	1.9
New Mexico	1	41	2.9
New York	1	15	1.1
Ohio	2	16	1.1
Oklahoma	2	129	9.2
Tennessee	2	205	14.6
Texas	39	374	26.7
Utah	1	211	15.0
Total	65	1404	100.0

ages, data will be presented describing the relationships between those demographic variables and the remaining age and time-interval variables.

For all analyses of the relationships between age or time-interval variables and demographic variables, statistical significance will be reported. Additionally, however, the correlation ratio (Eta^2) will be reported as an estimate of the magnitude of the relationships (i.e., educational significance). Given the large sample sizes for this study, even small and unimportant differences between or among means may be statistically significant. Therefore, Eta^2 values and standardized mean differences (SMDs) will be used to estimate the educational or practical significance of the differences between/among mean ages and time intervals.

We follow the data for SKI*HI overall by information collected using the identification-procedure questionnaire--specifically, who first suspected the hearing loss and what caused the suspicion. Then we will present data describing the identification procedures themselves, including data describing the relationship between each pair of age and time-interval variables. Finally, we will present the results of the multiple-regression analysis which was conducted to determine the optimal linear relationship between the identification variables and pretest receptive and expressive language quotients. To assist the reader in following the organization of this chapter, which includes an extensive number of tables, an outline of its contents follows:

A. Age of Identification
    1. Overall and by Program-Start Year
    2. Relationships with Demographic Variables:
        a. Gender
        b. Ethnicity
        c. Presence of Other Handicaps
        d. Type of Hearing Loss
        e. Severity of Hearing Loss
        f. Cause of Hearing Loss
        g. Age at Onset
        h. Language Spoken in the Home
        i. Parental Hearing Loss
    3. Identification-Age Summary
B. Age at Program Start
    1. Overall and by Program-Start year
    2. Relationships with Demographic Variables (only those that were statistically or educationally significant for Age of Identification):
        a. Presence of Other Handicaps
        b. Severity of Hearing Loss
        c. Cause of Hearing Loss
        d. Age at Onset
        e. Language Spoken in the Home
        f. Parental Hearing Loss
    3. Program-Start-Age Summary
C. Age Hearing Aid Fit
    1. Overall and by Program-Start year
    2. Relationships with Demographic Variables (only those that were statistically or educationally significant for Age of Identification):
        a. Presence of Other Handicaps
        b. Severity of Hearing Loss
        c. Cause of Hearing Loss
        d. Age at Onset
        e. Language Spoken in the Home
        f. Parental Hearing Loss

  - 3. Age-Hearing-Aid-Fit Summary
- D. Suspicion-to-Identification
  - 1. Overall and by Program-Start-Year Time Interval
  - 2. Relationships with Demographic Variables (only those that were statistically or educationally significant for Age of Identification):
    - a. Presence of Other Handicaps
    - b. Severity of Hearing Loss
    - c. Cause of Hearing Loss
    - d. Age at Onset
    - e. Language Spoken in the Home
    - f. Parental Hearing Loss
  - 3. Suspicion-to-ID-Time-Interval Summary
- E. Identification-to-Program-Start Time Interval
  - 1. Overall and by Program-Start year
  - 2. Relationships with Demographic Variables (only those that were statistically or educationally significant for Age of Identification):
    - a. Presence of Other Handicaps
    - b. Severity of Hearing Loss
    - c. Cause of Hearing Loss
    - d. Age at Onset
    - e. Language Spoken in the Home
    - f. Parental Hearing Loss
  - 3. ID-to-Program-Start-Time-Interval Summary
- F. Suspicion-to-Program-Start Time Interval
  - 1. Overall and by Program-Start year
  - 2. Relationships with Demographic Variables (only those that were statistically or educationally significant for Age of Identification):
    - a. Presence of Other Handicaps
    - b. Severity of Hearing Loss
    - c. Cause of Hearing Loss
    - d. Age at Onset
    - e. Language Spoken in the Home
    - f. Parental Hearing Loss
  - 3. Suspicion-to-Program-Start-Time-Interval Summary
- C. Who Suspected the Hearing Loss and What Caused the Suspicion
  - 1. Who Suspected the Hearing Loss
    - a. Frequencies and Percentages
    - b. Relationships with Age and Time Intervals
      - 1) Identification Age
      - 2) Program-Start Age
      - 3) Hearing-Aid-Fit Age
      - 4) Suspicion-to-Identification Time Interval
      - 5) Identification-to-Program-Start Time Interval
      - 6) Suspicion-to-Program-Start Time Interval
  - 2. What Caused the Suspicion
- F. Identification Procedures
  - 1. High-Risk Register
  - 2. NICU
  - 3. Frequencies
    - a. Children Referred by Screening Agency
    - b. Type of Referring Agency
  - 4. Age and Time Intervals
    - a. Identification Age
    - b. Program-Start Age
    - c. Hearing-Aid-Fit Age
    - d. Suspicion-to-Identification Time Interval
    - e. Identification-to-Program-Start Time Interval
    - f. Suspicion-to-Program-Start Time Interval
  - 5. Correlation Coefficients Among Age and Time-Interval Variables
- G. Multiple-Regression Analysis
- H. Summary

Age and Time-Interval Variables--SKI*HI Overall

Age of Identification

The identification date was provided by parent advisors on the SKI*HI data sheet and was defined as the first report from an audiologist indicating a hearing loss. The identification age was then calculated by subtracting the child's birth date from the identification date and converting the difference to months. As discussed in Chapter 2, the Joint Committee on Infant Hearing (1982) recommended that the hearing of any at-risk children should be screened not later than six months of age. Data were presented that described a wide range of mean identification ages that have been reported in recent literature. A question of interest, then, was whether the identification age for SKI*HI replication sites was equal to or better than that reported in the literature. The mean, standard deviation, and median ages of identification are provided for the children overall and for each program year in Table 47 and Figure 3. For 6% of the children (N = 330), age of identification was not reported by site personnel.

When the distribution of ages is skewed, the median more validly reflects average age of identification. Discounting the 1979-80 program year, which was the first year for submitting data to the national data bank and for which the sample size was exceptionally small, the medians ranged from 16 months to 19 months, with an overall median of 17 months. The means were consistently larger than the medians, ranging from 17.2 months to 19.8 months, with an overall mean of 18.9 months. The overall standard deviation of 13 was used in the calculation of the SMDs in this section.

The SKI*HI mean age of identification is excellent when compared with that reported by the Commission on Education of the Deaf (1988)--that is, 30 months for profoundly deaf children. By contrast, the SKI*HI overall mean identification age is consistent with that reported by Elssmann et al. (1987) of approximately 19 months, for a questionnaire study conducted in Arizona. Interestingly, Arizona adopted the SKI*HI model of home programming in 1978 on a statewide basis. However, site personnel elected not to participate in the

Table 47

Mean, Standard Deviation, and Median Age (in Months) at Which the Children Were Identified as Having a Hearing Loss, Overall and by Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	13.0	6.2	12	35
7-1-80 thru 6-30-81	17.2	10.0	16	130
7-1-81 thru 6-30-82	19.0	12.9	17	383
7-1-82 thru 6-30-83	19.1	13.3	17	563
7-1-83 thru 6-30-84	18.6	11.6	18	397
7-1-84 thru 6-30-85	19.3	12.5	18	398
7-1-85 thru 6-30-86	17.2	11.9	16	358
7-1-86 thru 6-30-87	18.8	12.6	17	499
7-1-87 thru 6-30-88	19.2	13.6	17	505
7-1-88 thru 6-30-89	19.3	13.1	18	537
7-1-89 thru 6-30-90	19.8	13.5	19	566
7-1-90 thru 6-30-91	19.1	14.5	16	477
Overall	18.9	13.0	17	4848

Note: Total children possible = 5,178.

national data bank. Although the Elssmann et al. study was smaller in scope and sample size, it is, in fact, an independent replication of the present investigation, because the majority of the children included in their study were served by a SKI*HI state-wide replication site.

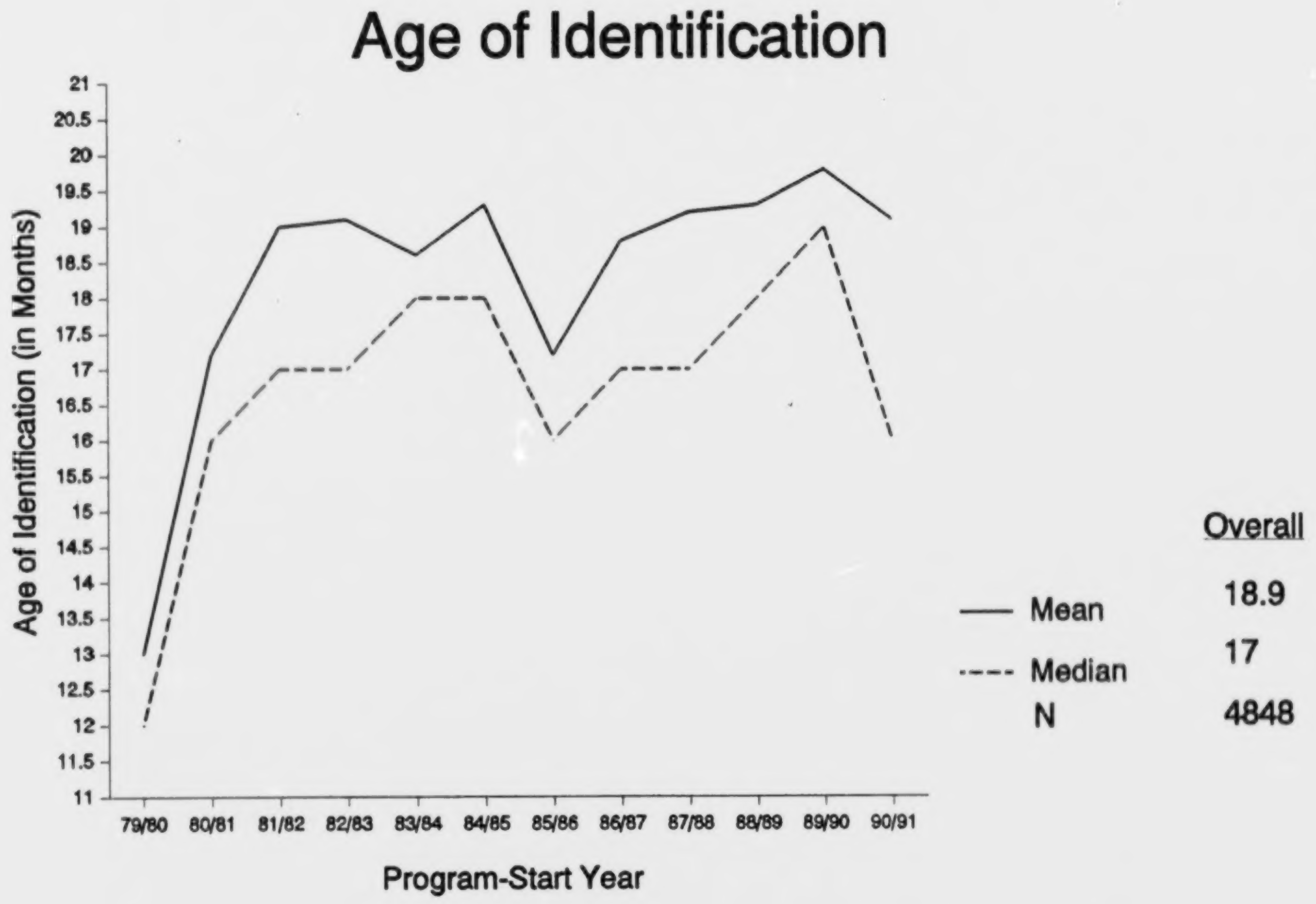

Figure 3. Mean and Median ages of identification by program-start year for SKI*HI overall.

Identification age by gender. As Table 48 indicates, the median identification ages for males and females were identical (17 months). Furthermore, there was no statistically significant difference between the mean ages of identification for males and females, with Eta^2 essentially zero. The SMD (.01) was practically nil.

Table 48

Mean, Standard Deviation, and Median Ages of Identification by Sex, 1979-1991

Sex	M	SD	Mdn	N
Male	19.0	12.9	17	2630
Female	18.9	13.0	17	2154
Overall	18.9	13.0	17	4784

Note: $\text{Eta}^2 = <.01$. No statistically significant difference between the means, $F(1,4782) = .04$, $p = .84$.

Identification age by ethnicity. For ethnicity, the medians for the ethnic groups were similar (Table 49), ranging from 16 months for Native Americans to 19 months for African and Spanish Americans. There was no statistically significant difference among the mean ages of identification, with Eta^2 again essentially zero. Again, the means are nearly identical, ranging from 17.2 months for Asian Americans to 19.9 months for African Americans. The SMDs were small, ranging from .02 to .21.

Table 49

Mean, Standard Deviation, and Median Ages of Identification by Ethnicity, 1979-1991

Ethnicity	M	SD	Mdn	N
Caucasian	18.7	13.1	17	3446
African American	19.9	12.6	19	685
Spanish American	19.3	13.0	19	456
Native American	17.5	12.1	16	99
Asian American	17.2	11.8	17	43
Other	18.0	11.0	17	57
Overall	18.9	12.9	17	4786

Note: $\text{Eta}^2 = <.01$. No statistically significant difference among the mean ages, $F(5,4780) = 1.53$, $p = .18$.

Identification age by presence of other handicaps. The median identification ages for children with and without an additional handicapping condition differed by 6 months (Table 50)--a large and important difference when considered in the context of learning language and communication during the early years of life. Children with an additional handicapping condition had a median identification age of 12 months. The difference between the means was statistically significant; however, Eta^2 was extremely small. Although the SMD was small (.31, or less than 1/3 of a standard deviation) by Cohen's (1988) standards, the actual mean difference was four months--again, a large difference for young children.

Table 50

Mean, Standard Deviation, and Median Ages of Identification by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	15.8	12.9	12	1150
No Other Handicap Present	19.8	12.8	18	3589
Overall	18.9	12.9	17	4739

Note: $Eta^2 = .02$. Statistically significant difference between the mean ages, $F(1,4737) = 86.7$, $p \leq .05$.

Identification age by type of hearing loss. The medians for children with different types of hearing loss were similar (Table 51), ranging from 15 months for children with mixed losses to 18 months for children with sensorineural losses. No statistically significant difference among the mean identification ages was obtained, with an Eta^2 of essentially zero. Children whose hearing loss was categorized as Not Yet Determined were not included in the analysis. The means ranged from 17.6 for children with mixed losses to 19.1 for children with sensorineural losses, with small SMDs, ranging from .00 to .11. Surprisingly, children with conductive hearing losses had a lower mean age of identification than children with sensorineural losses. Even after removing from the analysis of conductive hearing losses those children whose cause of hearing loss was atresia (a condition that is physically identifiable at birth), the mean identification age was only slightly higher (i.e., 20.1 months).

Table 51

Mean, Standard Deviation, and Median Ages of Identification by Type of Hearing Loss, 1979-1991

Type of Loss	M	SD	Mdn	N
Sensorineural	19.1	12.7	18	3913
Mixed	17.6	14.0	15	367
Conductive	18.4	14.7	16	306
Not Determined	18.4	12.8	16.5	150
Overall	18.9	13.0	17	4784

Note: $Eta^2 = <.01$. No statistically significant difference among the mean ages, $F(2,4583) = 2.4$, $p = .09$.

Identification age by severity of hearing loss. The median differences among the identification ages for the hearing-loss-severity levels were as large as 8 months (Table 52)--important differences from an intervention perspective. A statistically significant difference among the mean identification ages was obtained, with profoundly impaired children identified earlier than those with severe, moderate, mild, or no losses, and severely impaired children identified earlier than those with moderate, mild, or no losses. Although the Eta^2 was small, the SMDs ranged from small to medium (.18 to .49) by Cohen's (1988) standards. Actual mean differences were as large as 6.4 months.

Table 52

Mean, Standard Deviation, and Median Ages of Identification by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	22.5	13.9	23	156
Mild Loss	22.1	15.8	21	374
Moderate Loss	21.6	14.6	21	850
Severe Loss	18.4	12.2	17	1922
Profound Loss	16.1	10.1	15	974
Overall	19.0	12.9	17	4276

Note: Eta^2 = .03. Statistically significant difference among the mean ages, $F(4,4271) = 30.7$, $p \leq .05$.

Identification age by cause of hearing loss. The causes of hearing loss provided in Table 53 are arranged by medians from the youngest to the oldest median identification age. The median identification ages ranged from 9 months, for children born with a syndrome, to 23 months, for children who had experienced fever or infections--that is, a median difference of 14 months.

In addition, a statistically significant difference was obtained among the mean identification ages, with a small Eta^2 of .06. Children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Findings from the Tukey multiple-comparison test indicated that the mean identification ages for children whose cause of loss was fever or infection, middle-ear problems, or meningitis were significantly greater than the mean identification ages for children whose cause of loss was a syndrome, rubella, defects at birth, conditions during pregnancy (e.g., prematurity), or heredity. These findings are not surprising given that these latter causes are known high-risk indicators of hearing loss. If such risk factors were present at birth, professionals would have been alerted to the potential for hearing loss in the infant. The mean identification ages ranged from 11.9 months, for children born with a syndrome, to 22.8, for children who had experienced a fever or infection. That is, the maximum mean difference was nearly 11 months--again, an important difference from the perspective of early intervention. The *SMD*s ranged from small to large (i.e., .01 to .84) by Cohen's (1988) standards.

Table 53

Mean, Standard Deviation, and Median Ages of Identification for Cause of Hearing Loss, 1979-1991

Cause	*M*	*SD*	*Mdn*	*N*
Child Syndrome	11.9	12.7	9	138
Defects at Birth	13.2	13.2	10	235
Rubella/CMV	12.7	11.4	11	159
Conditions During Pregnancy	14.1	10.7	12	148
Heredity	15.2	12.7	12	501
Other Cause*	13.6	9.7	13	104
Rh Incompatibility or Kernicterus	16.2	11.0	15	33
Drugs During Pregnancy	19.1	14.1	16.5	26
Meningitis	19.0	11.9	17	603
Drugs Given to Child	19.7	13.9	17	44
Birth Trauma	19.0	14.0	18	134
Cause Not Reported*	20.6	13.8	19	91
Unknown Cause*	21.3	12.5	19	2277
Middle-Ear Problems	20.8	14.9	21	228
Fever or Infection in Child	22.8	13.1	23	127
Overall	18.9	13.0	17	4848

Note: Eta^2 = .06. Statistically significant difference among the mean ages, for known causes of hearing loss, $F(11,2364) = 13.4$, $p \le .05$.
* = Not included in the analysis.

Identification age by onset of hearing loss. For the five levels of age at onset (Table 54), the median ages of identification ranged from 12 months, for children with age at onset of at birth and birth to 1 year, to 47 months, for children with age at onset of 3 years or older--an extremely large difference. A statistically significant difference among the mean identification ages for the age-at-onset levels was obtained, with an Eta^2 of .15. Not surprisingly, the findings from the Tukey multiple-comparison test indicated that children whose age at onset was at birth or from birth to one year were identified at a significantly earlier age than children whose age at onset was one year or older. In fact, there were statistically significant differences among all of the mean ages of identification except between those for children whose onset was at birth and from birth to one year. The means ranged from 14.5 months to 49.2 months--again, important differences. The SMDs ranged from small to large (.12 to 2.67) by Cohen's (1988) standards.

Table 54

Mean, Standard Deviation, and Median Ages of Identification by Age at Onset of Unaided Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	14.5	12.6	12	1489
Birth to 1 Year	16.1	12.3	12	299
1 to 2 Years	20.2	6.5	19	206
2 to 3 Years	31.9	5.4	32	58
3 Years or Older	49.2	10.6	47	19
Overall	16.1	12.7	14	2071

Note: $Eta^2 = .13$. Statistically significant difference among the mean ages, $F(4,2066) = 75.4$, $p \leq .05$.

Identification age by language spoken in the home. The median identification ages for the levels of language spoken in the home ranged from 8 months, for homes in which ASL was primarily used, to 19 months, for homes in which Spanish was the primary language (Table 55). A statistically significant difference was obtained among the mean identification ages; however, Eta^2 was practically zero. Children from homes in which ASL was used obtained a significantly lower mean identification age (11 months) than children from homes in which English or Spanish was spoken (19.2 and 19.5, respectively). The SMDs ranged from small to medium (.34 to .65) by Cohen's (1988) standards. These findings are consistent with the early identification age reported previously for children whose cause of hearing loss was heredity. Again, because heredity is a known risk factor, it is likely that hearing-impaired parents using ASL anticipated the possibility of a hearing loss in their children and had them tested during the first year of life.

Table 55

Mean, Standard Deviation, and Median Ages of Identification by Language Spoken in the Home, 1979-1991

Language	M	SD	Mdn	N
English	19.2	13.0	18	4304
Spanish	19.5	12.5	19	234
ASL	11.0	10.8	8	128
Signed English	15.5	13.1	13	47
Other	15.4	11.1	16	71
Overall	18.9	13.0	17	4784

Note: Eta^2 = .01. Statistically significant difference among the means, $F(4,4779) = 15.0$, $p \leq .05$.

Identification age by parental hearing loss. The difference between the median identification ages for children with and without a parent with a hearing loss was 4.4 months (Table 56), favoring children with a hearing-impaired parent (SMD = .34). Furthermore, the difference between the mean identification ages was statistically significant; however, the Eta^2 was extremely small. Again, this finding is not surprising in light of the previously mentioned results related to early identification for children whose hearing loss was due to heredity. On average, children with a hearing-impaired parent were identified at approximately 15 months, compared to approximately 19 months for children without a hearing-impaired parent.

Table 56

Mean, Standard Deviation, and Median Ages of Identification by One or More Hearing Impaired Parent, 1979-1991

Parental Hearing Loss	M	SD	Mdn	N
One or More HI Parent	14.9	12.8	12	427
No HI Parent	19.3	12.9	18	4334
Overall	18.9	13.0	17	4761

Note: $Eta^2 = .01$. Statistically significant difference between the means, $F(1,4759) = 44.6$, $p \leq .05$.

Identification-Age Summary:

1. Overall, the median identification age was 17 months.
2. For children with additional handicapping conditions, the median identification age was 12 months.
3. For profoundly impaired children, the median identification age was 15 months.
4. For children whose cause of hearing loss was a known risk factor or was visually apparent at birth, the median identification age ranged

from 9 to 16.5 months.

5. For children whose age at onset was at birth or from birth to one year, the median identification age was 12 months.
6. For children from homes in which ASL and signed English were the primary languages, the median identification ages were 8 and 13 months, respectively.
7. For children with a hearing-impaired parent, the median identification age was 12 months.

Age at Program Start

The program-start date was routinely provided on the SKI*HI data sheets by the parent advisors and was defined as the date that any parent/infant program services were first given by personnel from the agency using the SKI*HI program. First-time services might have included the first telephone contact with the family by the assigned parent advisor, the first visit to the home when background information was collected, or the first actual home visit. The program-start age was then calculated by subtracting the birth date from the program-start date. Because early identification of hearing loss has little impact if intervention for language, communication, and auditory development are delayed, program-start age was considered a critical variable for these analyses.

The mean, standard deviation, and median program-start ages are provided for the children overall and for each program year in Table 57. For 3% of the children (*N* = 160), program-start age was either not reported or could not be calculated due to missing birth dates. Again, discounting the 1979-80 program years, for which the sample size was exceptionally small, the median program-start ages ranged from 20 to 26 months, with an overall median of 25 months. The means were consistently larger than the medians, ranging from 22.2 to 27.3 months, with an overall mean of 26.4 months. The overall standard deviation (14.1) was used in the calculation of *SMD*s in this section.

Elssmann et al. (1987) reported a mean age of intervention for the 125 children in their survey of approximately 25 months. However, these authors defined intervention-start age differently from the definitions used here for program-start age. Intervention-start age was defined as the age at which the majority of the children had been fitted with their first hearing aid. As you will see in the section of this chapter that follows, on average, hearing-aid-fit age was earlier than program-start age for the children in the SKI*HI data bank overall. Although the SKI*HI model includes a complete home hearing-aid program, children were sometimes not referred to the SKI*HI program by an audiologist until after the hearing aid had been fit, thereby losing critical months during which language and communication, as well as auditory, services could have been provided.

Table 57

Mean, Standard Deviation, and Median Age (in Months) at Program Start, Overall and By Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	15.1	7.2	14	36
7-1-80 thru 6-30-81	22.2	12.1	20	134
7-1-81 thru 6-30-82	27.7	15.1	25	391
7-1-82 thru 6-30-83	27.0	14.5	25	569
7-1-83 thru 6-30-84	26.1	13.8	25	422
7-1-84 thru 6-30-85	26.4	13.9	24	413
7-1-85 thru 6-30-86	24.5	13.3	23	368
7-1-86 thru 6-30-87	26.6	13.5	25	531
7-1-87 thru 6-30-88	26.7	14.2	26	531
7-1-88 thru 6-30-89	26.6	13.5	25	546
7-1-89 thru 6-30-90	27.3	14.4	26	575
7-1-90 thru 6-30-91	26.1	15.0	25	502
Overall	26.4	14.1	25	5018

Note: Total possible children = 5,178.

Program-start age by presence of other handicaps. The median program-start ages for children with and without an additional handicapping condition differed by 3 months (Table 58). Children with an additional handicapping condition had a median program-start age of 22 months. The difference between the means (2.3 months, SMD = .18) was statistically significant; however, the Eta^2 was again practically nil. An SMD of .16 was calculated, small by Cohen's standards.

Table 58

Mean, Standard Deviation, and Median Program-Start Ages by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	24.5	14.6	22	1206
No Other Handicap Present	26.8	13.8	25	3689
Overall	26.2	14.0	25	4895

Note: $\text{Eta}^2 = .01$. Statistically significant difference between the mean ages, $F(1,4893) = 25.5$, $p \leq .05$.

Program-start age by severity of hearing loss. The median differences among the program-start ages for the severity levels were as large as eight months (Table 59). Children with profound losses began the program at a median age of 21 months, and children with moderate, mild, and no losses began the program at median ages of 28 to 29 months. The differences among the means was statistically significant, with profoundly and severely impaired children beginning the program at significantly earlier ages than children with moderate, mild, or no losses. Although Eta^2 was small (.03), actual mean differences between the program-start ages were as large as 6.4 months, with small SMDs, ranging from .01 to .45.

Table 59

Mean, Standard Deviation, and Median Program-Start Ages by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	29.7	13.1	28	165
Mild Loss	29.6	16.0	29	383
Moderate Loss	28.9	14.8	28	868
Severe Loss	25.4	13.6	24	1962
Profound Loss	23.3	12.3	21	993
Overall	26.1	13.9	24	4371

Note: $\text{Eta}^2 = .03$. Statistically significant difference among the mean ages, $F(4,4366) = 29.7$, $p \leq .05$.

Program-start age by cause of hearing loss. The causes of hearing loss provided in Table 60 are arranged by medians, from the youngest to the oldest program-start age. The median program-start ages ranged from 18 months, for children whose mothers had contracted rubella or cytomegalovirus, to 30 months, for children for whom a fever or infection was the cause of the hearing loss (Table 60). The overall median was 25 months.

A statistically significant difference was obtained among the mean program-start ages; however, the Eta^2 was small (.04). Again, children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Post-hoc analyses indicated that the mean program-start ages of children whose cause of loss was fever or infections, birth trauma, or middle-ear problems were significantly greater than the mean program-start ages of children whose cause of loss was rubella, a child syndrome, conditions during pregnancy, heredity, or defects at birth. These findings are consistent with those obtained for identification age by cause of hearing loss. The mean program-start ages ranged from 21 months to 31.8 months--that is, a difference of 10.8 months, which is consistent with that reported previously for identification age. The SMDs ranged from small to large (.01 to .77) by Cohen's (1988) standards.

Table 60

Mean, Standard Deviation, and Median Program-Start Ages for Cause of Hearing Loss, 1979-1991

Cause	M	SD	Mdn	N
Rubella/CMV	21.0	14.0	18	164
Child Syndrome	22.1	14.9	19	141
Other Cause*	23.0	12.7	20.5	112
Conditions During Pregnancy	22.4	12.0	21	151
Defects at Birth	23.7	15.3	21	244
Drugs During Pregnancy	26.5	16.5	21.5	26
Heredity	22.9	14.3	22	507
RH Incompatibility or Kernicterus	25.5	13.0	24	35
Meningitis	26.0	13.2	24	616
Unknown Cause*	27.8	13.7	26	2349
Drugs Given to Child	26.6	16.0	27	45
Birth Trauma	28.8	16.1	27	138
Middle-Ear Problems	28.5	14.5	28	248
Cause Not Reported*	28.7	14.7	28.5	114
Fever or Infection in Child	31.8	12.8	30	128
Overall	26.4	14.1	25	5018

Note: Eta^2 = .04. Statistically significant difference among the mean ages for known causes of hearing loss, $F(11,2431) = 8.8$, $p \le .05$. * = Not included in the analysis.

Program-start age by onset of hearing loss. For the five levels of age at onset (Table 61), the median program-start ages ranged from 21 months, for children with age at onset of at birth and birth to one year, to 51.5 months, for children with age at onset of three years or older--an extremely large difference. A statistically significant difference among the mean program-start ages was obtained, with an Eta^2 of .06. The post-hoc analyses indicated that children whose age at onset of hearing loss was at birth or from birth to one year began the program at a significantly earlier age than children whose age at onset was one year or older. Statistically significant differences were obtained among all of the mean program-start ages except between those for children whose onset was at birth and from birth to one year. The means ranged from 23.2 months to 53.7 months, with the SMDs ranging from small to large (.08 to 2.16) by Cohen's (1988) standards.

Table 61

Mean, Standard Deviation, and Median Program-Start Ages by Age at Onset of Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	23.2	14.4	21	1527
Birth to 1 Year	24.3	14.7	21	304
1 to 2 Years	25.7	9.1	24	213
2 to 3 Years	35.9	7.4	35	62
3 Years or Older	53.7	11.9	51.5	18
Overall	24.3	14.3	22	2124

Note: $\text{Eta}^2 = .06$. Statistically significant difference among the mean ages, $F(4,2119) = 34.1$, $p \leq .05$.

Program-start age by language spoken in the home. The median program-start for the levels of language spoken in the home ranged from 15 months, for homes in which ASL was the primary language, to 27 months, for homes in which Spanish was the primary language (Table 62). A statistically significant difference was obtained among the mean program-start ages; however, again the Eta^2 was extremely small. Children from homes in which ASL was used obtained a significantly lower mean program-start age (17.9 months) than children from homes in which English, Spanish, or other languages were spoken. This finding is consistent with those reported previously for identification age. The SMDs ranged from nil to medium (.00 to .64) by Cohen's (1988) standards.

Table 62

Mean, Standard Deviation, and Median Program-Start Ages by Language Spoken in the Home, 1979-1991

Language	M	SD	Mdn	N
English	26.6	14.2	25	4453
Spanish	26.9	13.1	27	237
ASL	17.9	11.6	15	132
Signed English	23.3	14.1	20.5	50
Other	26.6	13.0	26	76
Overall	26.4	14.1	25	4948

Note: $\text{Eta}^2 = .01$. Statistically significant difference among the means, $F(4,4943) = 13.0$, $p \leq .05$.

Program-start age by parental hearing loss. The difference between the median program-start ages for children with and without a parent with a hearing loss was four months (Table 63), favoring children with a hearing-impaired parent. The difference between the mean program-start ages was statistically significant; however, the Eta^2 was extremely small. On average, children with a hearing-impaired parent started the program at 22.8 months of age, compared to 26.6 months for children without a hearing-impaired parent (small SMD = .27). This finding is consistent with that reported previously for identification age.

Table 63

Mean, Standard Deviation, and Median Program-Start Ages by One or More Hearing-Impaired Parent, 1979-1991

Parental Hearing Loss	M	SD	Mdn	N
One or More HI Parent	22.8	14.6	21	442
No HI Parent	26.6	14.0	25	4472
Overall	26.3	14.1	25	4914

Note: $Eta^2 = .01$. Statistically significant difference between the means, $F(1,4912) = 30.6$, $p \leq .05$.

Program-Start-Age Summary

1. Overall, the median program-start age was 25 months.
2. For children with additional handicapping conditions, the median program-start age was 22 months.
3. For profoundly impaired children, the median program-start age was 21 months.
4. For children whose cause of hearing loss was a known risk factor or was visually apparent at birth, the median program-start-age ranged from 18 to 24 months.
5. For children whose age at onset was at birth or from birth to one year, the median program-start age was 21 months.
6. For children from homes in which ASL and signed English were the primary languages, the median program-start ages were 15 and 20.5 months, respectively.
7. For children with a hearing-impaired parent, the median program-start age was 21 months.

Age Hearing Aid Fit

Parent advisors were instructed to write on the SKI*HI data sheet the date when an aid, either trial or permanent, was first fit by any agency for each child served. Hearing aids were not recommended for all children by the attending audiologist in a number of different situations (e.g., fluctuating conductive losses due to middle-ear problems, child intolerance of amplification, and problems with fitting a multiply handicapped child). Consequently, for 22% of the children (N = 1,152), either a hearing-aid-fit date was not applicable or not reported or hearing-aid-fit age could not be calculated due to missing birth dates.

The mean, standard deviation, and median hearing-aid-fit ages are provided for the children overall and for each program year in Table 64. Again, discounting the 1979-80 program year, for which the sample size was exceptionally small, the median hearing-aid-fit ages ranged from 20 to 23 months, with an overall median of 22 months. The means were consistently larger than the medians, ranging from 21.6 to 24.9 months, with an overall mean of 23.8 months. The overall standard deviation (13.1) was used in the calculation of SMDs in this section.

As reported earlier in this chapter, the overall median identification age was 17 months (M = 18.9 months). The median delay, then, between identification age and hearing-aid-fit age was approximately 5 months (M delay of approximately 5 months). This finding is consistent with that reported by Elssmann et al. (1987), who indicated that audiologists had contributed, "on average, as much as six additional months to the process--that is, the delay between age of identification and the age at which the initial hearing aid had been fitted" (p. 17).

Table 64

Mean, Standard Deviation, and Median Age (in Months) at which a Hearing Aid was Fit, Overall and by Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	18.4	9.8	17	35
7-1-80 thru 6-30-81	21.6	10.7	20	118
7-1-81 thru 6-30-82	23.9	12.7	22	321
7-1-82 thru 6-30-83	24.0	13.0	22	468
7-1-83 thru 6-30 84	23.7	12.1	23	310
7-1-84 thru 6-30-85	23.0	12.4	21	330
7-1-85 thru 6-30-86	23.1	13.1	20	294
7-1-86 thru 6-30-87	24.0	13.1	22	441
7-1-87 thru 6-30-88	24.7	13.7	23	442
7-1-88 thru 6-30-89	24.1	12.6	23	447
7-1-89 thru 6-30-90	24.9	14.1	23	477
7-1-90 thru 6-30-91	23.2	14.1	21	343
Overall	23.8	13.1	22	4026

Note: Total children possible = 5,178.

Hearing-aid-fit age by presence of other handicaps. The median hearing-aid-fit age for children with and without an additional handicapping condition differed by three months (Table 65). Children with an additional handicapping condition had a median hearing-aid-fit age of 19 months; those without an additional handicapping condition had a median age of 22 months. The difference between the mean hearing-aid-fit ages was statistically significant; however, the Eta^2 was practically nil (.01). A small SMD (.18) was calculated.

Table 65

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	22.0	13.6	19	881
No Other Handicap Present	24.3	12.8	22	3055
Overall	23.8	13.1	22	3936

Note: Eta^2 = .01. Statistically significant difference between the mean ages, $F(1,3934) = 19.8$, $p \leq .05$.

Hearing-aid-fit age by severity of hearing loss. The median differences among the hearing-aid-fit ages for the severity levels were as large as 9 1/2 months (Table 66), with profound and severely impaired children obtaining the youngest median hearing-aid-fit ages (19 and 22 months, respectively). The difference among the means was statistically significant, with profoundly and severely hearing-impaired children fit with hearing aids at significantly earlier ages than children with moderate, mild, or no losses. Although Eta^2 was small (.04), actual differences between the hearing-aid-fit ages were as large as 8.4 months. The SMDs ranged from small to medium (.02 to .64) by Cohen's (1988) standards.

Table 66

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	29.1	15.8	28.5	34
Mild Loss	28.9	15.9	27.5	258
Moderate Loss	27.3	14.6	26	725
Severe Loss	23.2	12.3	22	1716
Profound Loss	20.7	10.4	19	869
Overall	23.9	13.0	22	3602

Note: Eta^2 = .04. Statistically significant difference among the mean ages, $F(4,3597) = 39.1$, $p \leq .05$.

Hearing-aid-fit age by cause of hearing loss. The causes of hearing loss provided in Table 67 are arranged by median, from the youngest to the oldest hearing-aid-fit age. The medians ranged from 17 months, for children whose mothers had contracted rubella or cytomegalovirus, to 30 months, for children for whom a fever or infection was the suspected cause of the hearing loss. The overall median was 22 months.

A statistically significant difference among the mean hearing-aid-fit ages was obtained; however, the Eta^2 was small (.04). Again, children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Post-hoc analyses indicated that the mean hearing-aid-fit age for children whose cause of loss was fever or infections was significantly later than the mean hearing-aid-fit age for children whose cause of hearing loss was a syndrome, rubella, conditions during pregnancy, heredity, defects at birth, meningitis, and middle-ear infections. The mean hearing-aid-fit ages ranged from 19.1 to 30.9--a difference as large as 11.8 months, which is consistent with that reported previously for identification age and program-start age. The SMDs ranged from small to large (.01 to .90) by Cohen's (1988) standards.

Table 67

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by Cause of Hearing Loss, 1979-1991

Cause	M	SD	Mdn	N
Rubella/CMV	19.1	12.3	17	131
RH Incompatibility/Kernicterus	22.0	13.5	17	31
Conditions During Pregnancy	20.4	10.8	18	128
Defects at Birth	21.0	13.6	18	189
Heredity	20.9	13.4	19	410
Child Syndrome	22.1	14.9	19	141
Middle-Ear Problems	23.9	17.8	19	85
Other Cause*	20.2	10.4	20	86
Drugs During Pregnancy	23.4	12.6	20	19
Meningitis	23.4	11.6	21	526
Cause Not Reported*	26.1	13.6	23	72
Unknown Cause*	25.3	12.8	24	2000
Birth Trauma	25.5	14.6	24	109
Drugs Given to Child	25.2	14.5	25.5	44
Fever or Infection in Child	30.9	13.0	30	80
Overall	23.8	13.1	22	4026

Note: $Eta^2 = .04$. Statistically significant difference among the mean ages, for known causes of hearing loss, $F(11,1856) = 7.0$, $p \leq .05$.
* = Not included in the analysis.

Hearing-aid-fit age by onset of hearing loss. For the five levels of age at onset, the median hearing-aid-fit ages ranged from 18 months, for children with age at onset of at birth and birth to one year, to 47 months, for children with age at onset of three years or older--an extremely large difference (Table 68). A statistically significant difference among the mean hearing-aid-fit ages was obtained, with a low Eta^2 (.08). Post-hoc analyses indicated that children whose age at onset of hearing loss was at birth or from birth to one year were fit with hearing aids at a significantly earlier age than children whose age at onset was two years or older. Statistically significant differences were obtained among all of the mean hearing-aid-fit ages, except between those for children whose onset was at birth and from birth to one ear and between those for children whose onset was from birth to one year and from one to two years. The means ranged from 20.8 months to 51.4 months, with the SMDs ranging from small to large (.05 to 2.34) by Cohen's (1988) standards.

Table 68

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by Age at Onset of Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	20.8	13.1	18	1224
Birth to 1 Year	21.5	12.8	18	253
1 to 2 Years	23.9	8.1	22	193
2 to 3 Years	34.6	7.9	35	48
3 Years or Older	51.4	11.1	47	14
Overall	21.9	13.0	19	1732

Note: $\text{Eta}^2 = .08$. Statistically significant difference among the mean ages, $\underline{F}(4,1727) = 35.9$, $\underline{p} \leq .05$.

Hearing-aid-fit age by language spoken in the home. The median hearing-aid-fit ages for the levels of language spoken in the home ranged from 16 months, for homes in which ASL was the primary language, to 26 months, for homes in which Spanish and other languages were the primary languages (Table 69). Although Eta^2 was practically zero (.01), a statistically significant difference was obtained among the mean hearing-aid-fit ages, favoring children from homes in which ASL or signed English was the primary language (Ms = 17.3 and 22.4, respectively). These findings are consistent with those reported previously for identification age and program-start age. The SMDs ranged from small to medium (.09 to .65) by Cohen's (1988) standards.

Table 69

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by Language Spoken in the Home, 1979-1991

Language	M	SD	Mdn	N
English	23.9	13.2	22	3624
Spanish	25.8	11.7	26	177
ASL	17.3	9.7	16	93
Signed English	22.4	15.6	18.5	40
Other	25.1	12.3	26	57
Overall	23.8	13.1	22	3991

Note: Eta^2 = .01. Statistically significant difference among the means, $F(4,3986) = 7.1$, $p \leq .05$.

Hearing-aid-fit age by parental hearing loss. The difference between the median hearing-aid-fit ages for children with and without a parent with a hearing loss was 3 months (Table 70), favoring children with a hearing-impaired parent. Although the Eta^2 was extremely small (<.01), the difference between the means was statistically significant. On average, children with a hearing-impaired parent were fit with a hearing aid at approximately 21 months, compared to approximately 24 months for children without a hearing-impaired parent. The SMD was small (.21).

Table 70

Mean, Standard Deviation, and Median Hearing-Aid-Fit Ages by One or More Hearing Impaired Parent, 1979-1991

Parental Hearing Loss	M	SD	Mdn	N
One or More HI Parent	21.2	13.2	19	332
No HI Parent	24.0	13.0	22	3637
Overall	23.8	13.1	22	3969

Note: Eta^2 = <.01. Statistically significant difference between the means, $F(1,3967) = 13.9$, $p \leq .05$.

Hearing-Aid-Fit-Age Summary

1. Overall, the median hearing-aid fit age was 22 months.
2. For children with additional handicapping conditions, the median hearing-aid fit age was 19 months.
3. For profoundly impaired children, the median hearing-aid-fit age was 19 months.
4. For children whose cause of hearing loss was a known risk factor or was visually apparent at birth, the median hearing-aid-fit age ranged from 17 to 19 months.
5. For children whose age at onset was at birth or from birth to one year, the median hearing-aid-fit age was 18 months.
6. For children from homes in which ASL and signed English were the primary languages, the median hearing-aid-fit ages were 16 and 18.5 months, respectively.
7. For children with a hearing-impaired parent, the median hearing-aid-fit age was 19 months.

Suspicion-to-Identification Time Interval

Parent advisors were requested to provide the date the parents first suspected the hearing loss in their child. If parents did not suspect any hearing loss before formal identification, then the identification date was recorded for date of suspicion. The time interval between suspicion age and identification age was calculated for this study by subtracting the suspicion age from the identification age and converting the difference to months. For 15% of the children (*N* = 762) an interval between suspicion and identification could not be calculated, because one or both values were not reported.

The mean, standard deviation, and median intervals between suspicion and identification are provided in Table 71 for the children overall and for each program year. The median suspicion-to-identification time intervals ranged from two to four months, with an overall median of three months. Interestingly, the median interval has remained at two months for the last six program years.

Table 71

Mean, Standard Deviation, and Median Time Interval (in Months) Between Age of Suspicion and Age of Identification of Hearing Loss, Overall and by Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	4.1	3.3	3	31
7-1-80 thru 6-30-81	5.3	5.0	3.5	120
7-1-81 thru 6-30-82	6.5	6.9	4	345
7-1-82 thru 6-30-83	6.5	7.4	4	495
7-1-83 thru 6-30-84	6.3	7.0	4	339
7-1-84 thru 6-30-85	5.4	6.3	3	358
7-1-85 thru 6-30-86	4.9	7.5	2	315
7-1-86 thru 6-30-87	5.4	7.8	2	451
7-1-87 thru 6-30-88	4.8	6.4	2	473
7-1-88 thru 6-30-89	5.4	7.8	2	507
7-1-89 thru 6-30-90	5.8	7.7	2	531
7-1-90 thru 6-30-91	5.9	9.0	2	451
Overall	5.7	7.4	3	4416

Note: Total children possible = 5,178.

The means were consistently larger than the medians, ranging from 4.1 to 6.5 months, with an overall mean of 5.7 months. The overall standard deviation (7.4) was used in the calculation of SMDs in this section. The average suspicion-to-identification time interval for this study was slightly smaller than the 6.6 to 7.1 months reported by Elssmann et al. (1987). Elssmann et al. did not report medians, so a comparison cannot be made for that statistic.

Suspicion-to-identification time interval by presence of other handicaps. The median suspicion-to-identification time intervals for children with and without an additional handicapping condition were identical (three months), as shown in Table 72. Although the difference between the mean intervals was statistically significant, the Eta^2 was essentially zero and the actual mean difference was only .6 of a month (SMD = .08).

Table 72

Mean, Standard Deviation, and Median Interval Between Suspicion and Identification by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	5.2	7.2	3	1055
No Other Handicap Present	5.8	7.5	3	3268
Overall	5.6	7.4	3	4323

Note: Eta^2 = <.01. Statistically significant difference between the mean ages, $F(1,4321) = 4.1$, $p \leq .05$.

Suspicion-to-identification time interval by severity of hearing loss. The median differences among the suspicion-to-identification time intervals for the severity levels were small, ranging from two to three months (Table 73). Although the difference among the mean intervals was statistically significant, the Eta^2 was essentially zero and the largest actual mean difference between severity levels was only 1.4 months. The interval for children with profound losses was statistically significantly smaller than that for children with moderate losses. The SMDs ranged from nil to small (.00 to .19) by Cohen's (1988) standards.

Table 73

Mean, Standard Deviation, and Median Interval Between Suspicion and Identification by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	6.4	9.3	2	142
Mild Loss	5.9	8.4	2	338
Moderate Loss	6.4	8.4	3	790
Severe Loss	5.6	7.2	3	1784
Profound Loss	5.0	6.2	3	894
Overall	5.7	7.5	3	3948

Note: $Eta^2 = <.01$. Statistically significant difference among the mean ages, $F(4,3943) = 4.4$, $p \leq .05$.

Suspicion-to-identification time interval by cause of loss. The causes of hearing loss provided in Table 74 are arranged by median, from the smallest to the largest suspicion-to-identification time intervals. The medians ranged from one month, for children for whom the cause of hearing loss was meningitis and defects at birth, to four months, for children for whom Rh incompatibility, drugs during pregnancy, fever or infection in the child, or birth trauma was the cause of hearing loss. The overall median was three months.

A statistically significant difference among the mean suspicion-to-identification time intervals was obtained; however, the Eta^2 was practically nil (.01). Again, children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Post-hoc analyses indicated that the mean time interval for children whose cause of loss was meningitis was significantly smaller than the mean interval for children whose cause of hearing loss was either birth trauma or fever or infection. The mean intervals ranged from 4 to 6.7 months--that is, the largest mean difference was 2.7 months. The SMDs ranged from nil to small (.00 to .36) by Cohen's (1988) standards.

Table 74

Mean, Standard Deviation, and Median Intervals Between Suspicion and Identification by Cause of Hearing Loss, 1979-1991

Cause	M	SD	Mdn	N
Meningitis	4.0	7.0	1	557
Defects at Birth	4.5	7.3	1	224
Child Syndrome	4.4	7.4	2	127
Rubella/CMV	5.1	7.6	2	147
Middle-Ear Problems	5.7	8.7	2	208
Heredity	5.3	6.9	3	464
Conditions During Pregnancy	5.8	7.5	3	142
Drugs Given to Child	6.0	10.8	3	41
Rh Incompatibility/Kernicterus	5.5	6.0	4	33
Drugs During Pregnancy	6.0	8.7	4	21
Other Cause *	6.1	7.4	4	87
Unknown Cause *	6.2	7.2	4	2065
Fever or Infection in Child	6.6	7.5	4	108
Birth Trauma	6.7	8.3	4	125
Cause Not Reported *	6.7	8.5	4	67
Overall	5.7	7.4	3	4416

Note: $\text{Eta}^2 = .01$. Statistically significant difference among the mean ages, for known causes of hearing loss, $F(11,2185) = 2.6$, $p \leq .05$.
* Not included in analysis.

Suspicion-to-identification time interval by onset of hearing loss. For the five levels of age at onset, the median suspicion-to-identification time intervals ranged from one month, for children with age at onset of at birth and birth to one year, to two months, for children with age at onset of one year or older--a small difference (Table 75). Although a statistically significant difference among the mean intervals was obtained, the Eta^2 was practically zero (.01). Post-hoc analyses indicated that the mean time interval for children whose age at onset was at birth was statistically significantly larger than the mean interval for children whose age at onset was one-to-two years. The mean intervals ranged from 3 months to 5.6 months, with small SMDs (.04 to .35) by Cohen's (1988) standards.

Table 75

Mean, Standard Deviation, and Median Intervals Between Suspicion and Identification by Age at Onset of Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	5.3	7.4	2	1390
Birth to 1 Year	5.0	7.8	2	280
1 to 2 Years	3.5	5.2	2	195
2 to 3 Years	3.0	4.6	1	58
3 Years or Older	5.6	13.1	1	19
Overall	5.0	7.3	2	1942

Note: $\text{Eta}^2 = .01$. Statistically significant difference among the mean ages, $F(4,1937) = 3.8$, $p \leq .05$.

Suspicion-to-identification time interval by language spoken in the home. The median suspicion-to-identification time intervals for the levels of language spoken in the home ranged from two to three months (Table 76)--a very small difference. No statistically significant difference among the mean intervals was obtained, and Eta^2 was essentially zero (<.01). The mean intervals ranged from 4.8 to 5.7 months, with small and unimportant differences between pairs of means. The SMDs were small (.04 to .16) by Cohen's (1988) standards.

Table 76

Mean, Standard Deviation, and Median Intervals Between Suspicion and Identification by Language Spoken in the Home, 1979-1991

Language	M	SD	Mdn	N
English	5.7	7.4	3	3920
Spanish	6.0	8.3	3	219
ASL	5.1	6.5	2.5	112
Signed English	5.4	6.8	3	46
Other	4.8	5.3	2	62
Overall	5.6	7.4	3	4359

Note: Eta^2 = <.01. No Statistically significant difference among the means, $F(4,4354) = .51$, $p = .72$.

Suspicion-to-identification time interval by parental hearing loss. The median suspicion-to-identification time intervals for children with and without a parent with a hearing loss were identical (three months), as shown in Table 77. Furthermore, the difference between the mean intervals was not statistically significant, and Eta^2 was essentially zero (<.01). On average, the mean identification-to-program start interval for children with a hearing-impaired parent was 5.9 months, compared to 5.6 months for children without a hearing-impaired parent (SMD = .04).

Table 77

Mean, Standard Deviation, and Median Intervals Between Suspicion and Identification by One or More Hearing-Impaired Parent, 1979-1991

Parental Hearing Loss	M	SD	Mdn	N
One or More HI Parent	5.9	7.5	3	386
No HI Parent	5.6	7.4	3	3968
Overall	5.7	7.4	3	4354

Note: Eta^2 = <.01. No Statistically significant difference between the means, $F(1,4352) = .31$, $p = .58$.

Suspicion-to-Program-Start-Interval Summary

1. Overall, the median suspicion-to-identification time interval was 3 months.
2. The median suspicion-to-identification time interval was smallest (1 month) for children whose cause of hearing loss was meningitis or defects at birth and for children whose age at onset was two years or older.

Identification-to-Program-Start Time Interval

The identification-to-program-start time interval was computed by subtracting the identification date from the program-start date and converting the difference into months. For 7% of the children (N = 379) an interval between identification and program start could not be calculated because one or both values were not reported.

The mean, standard deviation, and median intervals between identification and program start are provided in Table 78 for the children overall and for each program year. The median identification-to-program-start intervals ranged from two to four months, with an overall median of four months. For six of the last seven years, the median interval has remained at three months. The means were consistently larger than the medians. Again, discounting the 1979-80 program year, for which the sample size was exceptionally small, the mean intervals ranged from 5.2 to 8.8 months, with an overall mean interval of 7.2 months. The overall standard deviation of 9.2 was used in the calculation of the SMDs in this section.

Table 78

Mean, Standard Deviation, and Median Intervals Between Identification Age and Program-Start Age, Overall and By Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	3.1	3.0	2	34
7-1-80 thru 6-30-81	5.2	7.7	2	128
7-1-81 thru 6-30-82	8.8	10.1	4	374
7-1-82 thru 6-30-83	7.7	9.4	4	546
7-1-83 thru 6-30-84	7.4	8.8	4	392
7-1-84 thru 6-30-85	6.8	8.5	3	390
7-1-85 thru 6-30-86	7.0	8.7	3	357
7-1-86 thru 6-30-87	7.6	9.6	4	496
7-1-87 thru 6-30-88	6.9	8.8	3	505
7-1-88 thru 6-30-89	7.1	9.1	3	535
7-1-89 thru 6-30-90	7.2	9.7	3	565
7-1-90 thru 6-30-91	6.8	9.2	3	477
Overall	7.2	9.2	4	4799

Note: Total children possible = 5,178.

Identification-to-program-start time interval by presence of other handicaps. The median identification-to-program-start time intervals for children with and without an additional handicapping condition were four and three months, respectively (Table 79). Although the difference between the mean intervals was statistically significant, the Eta^2 was practically nil and the actual mean difference was 1.5 months (SMD = .16), favoring children without an additional handicapping condition.

Table 79

Mean, Standard Deviation, and Median Intervals Between Identification and Program Start by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	8.3	10.1	4	1140
No Other Handicap Present	6.8	8.8	3	3554
Overall	7.2	9.1	3	4694

Note: $Eta^2 = .01$. Statistically significant difference between the mean ages, $F(1,4692) = 24.3$, $p \leq .05$.

Identification-to-program-start time interval by severity of hearing loss. The median differences among the suspicion-to-identification time intervals for the severity levels were small, ranging from three to four months (Table 80). The difference among the mean intervals was not statistically significant, and the Eta^2 was essentially zero. The largest actual mean difference between severity levels was only .4 months. The SMDs ranged from nil to small (.00 to .04) by Cohen's (1988) standards.

Table 80

Mean, Standard Deviation, and Median Interval Between Identification and Program Start by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	7.2	9.2	3	156
Mild Loss	7.2	10.2	3	369
Moderate Loss	7.3	9.4	4	842
Severe Loss	6.9	8.7	3	1906
Profound Loss	7.0	8.9	3	968
Overall	7.0	9.0	3	4241

Note: $\text{Eta}^2 = <.01$. No statistically significant difference among the mean ages, $F(4,4236) = .36$, $p = .84$.

Identification-to-program-start time interval by cause of hearing loss. The causes of hearing loss provided in Table 81 are arranged by median, from the smallest to the largest identification-to-program-start time intervals. The medians ranged from three months, for children for whom the cause of hearing loss was meningitis, drugs during pregnancy, middle-ear problems, and Rh incompatibility, to six months, for children for whom a syndrome was the cause of hearing loss. The overall median was four months.

A statistically significant difference among the mean identification-to-program-start time intervals was obtained; however, the Eta^2 was practically nil (.01). Again, children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Post-hoc analyses indicated that the mean identification-to-program-start interval for children whose cause of loss was meningitis was statistically significantly smaller than the mean interval for children whose cause of hearing loss was either birth trauma or defects at birth. The mean intervals ranged from 6.3 to 9.9 months--that is, the largest mean difference was 3.6 months. The SMDs ranged from nil to small (.00 to .36) by Cohen's (1988) standards.

Table 81

Mean, Standard Deviation, and Median Intervals Between Identification and Program Start by Cause of Hearing Loss, 1979-1991

Cause	M	SD	Mdn	N
Unknown Cause *	6.3	8.3	3	2253
Meningitis	6.8	8.8	3	596
Drugs During Pregnancy	7.3	9.8	3	26
Middle-Ear Problems	7.4	9.4	3	227
RH Incompatibility/Kernicterus	8.8	11.2	3	33
Heredity	7.4	9.1	4	492
Drugs Given to Child	7.4	7.9	4	44
Cause Not Reported *	7.7	9.9	4	91
Defects at Birth	9.9	12.5	4	235
Fever or Infection in Child	8.8	10.4	4.5	124
Rubella/CMV	8.2	10.4	5	157
Conditions During Pregnancy	8.6	9.0	5	147
Other Cause *	9.3	10.9	5	104
Birth Trauma	9.9	10.9	5	133
Child Syndrome	9.6	9.8	6	137
Overall	7.2	9.2	4	4799

Note: $\text{Eta}^2 = .01$. Statistically significant difference among the mean ages, for known causes of hearing loss, $F(11,2339) = 2.8$, $p \leq .05$.
* Not included in analysis.

Identification-to-program-start time interval by age at onset of loss. For the five levels of age at onset, the median identification-to-program-start time intervals ranged from 2 1/2 months, for children with age at onset of two years or greater, to 4 months, for children with age at onset at birth or at birth to one year (Table 82). Although a statistically significant difference among the mean intervals was obtained, the Eta^2 was practically zero (.01). Post-hoc analyses indicated that the mean intervals for children whose age at onset was at birth and at birth to one year were statistically significantly larger than the mean intervals for children whose age at onset was one-to-two and two-to-three years. The mean intervals ranged from 3.8 months to 8.5 months. The SMDs ranged from small to medium (.02 to .51).

Table 82

Mean, Standard Deviation, and Median Intervals Between Identification and Program Start by Age at Onset of Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	8.5	10.1	4	1475
Birth to 1 Year	8.3	10.4	4	295
1 to 2 Years	5.6	7.3	3	205
2 to 3 Years	4.4	5.5	2.5	58
3 Years or Older	3.8	3.4	2.5	18
Overall	8.0	9.8	4	2051

Note: $Eta^2 = .01$. Statistically significant difference among the mean ages, $F(4,2046) = 7.1$, $p \leq .05$.

Identification-to-program-start time interval by language spoken in the home. The median identification-to-program-start intervals for the levels of language spoken in the home ranged from three to six months (Table 83). Although a statistically significant difference among the mean intervals was obtained, Eta^2 was essentially zero (<.01). The mean intervals ranged from 6.4 to 11.1 months. Children from homes in which other languages were spoken obtained a statistically significantly larger mean interval than children from homes in which English, Spanish, or ASL were the primary languages. The largest difference between pairs of means was 4.7 months, favoring children from homes in which ASL was the primary language. The SMDs ranged from small to medium (.01 to .51) by Cohen's (1988) standards.

The median and mean for children from homes in which other languages were spoken were strikingly large (6 and 11.1 months, respectively). It is possible that because of language barriers, families who spoke minority languages other than Spanish did not understand the written or spoken communication detailing services for their children. It is equally possible that because of cultural differences regarding handicapping conditions, such families did not initially accept services that were available for their children.

Table 83

Mean, Standard Deviation, and Median Intervals Between Identification and Program Start by Language Spoken in the Home, 1979-1991

Language	M	SD	Mdn	N
English	7.2	9.1	3	4262
Spanish	7.3	9.4	4	230
ASL	6.4	7.9	4	127
Signed English	7.7	10.3	3	47
Other	11.1	13.1	6	71
Overall	7.2	9.2	4	4737

Note: $\text{Eta}^2 = <.01$. Statistically significant difference among the means, $F(4,4732) = 3.5$, $p \leq .05$.

Identification-to-program-start time interval by parental hearing loss. The median identification-to-program-start time intervals for children with and without a parent with a hearing loss were four and three months, respectively (Table 84). No statistically significant difference between the mean intervals was obtained, and Eta^2 was essentially zero (<.01). The mean identification-to-program-start interval for children with a hearing-impaired parent was 7.6 months, compared to 7.2 months for children without a hearing-impaired parent (SMD = .04).

Table 84

Mean, Standard Deviation, and Median Intervals Between Identification and Program Start by One or More Hearing-Impaired Parent, 1979-1991

Parental Hearing Loss	M	SD	Mdn	N
One or More HI Parent	7.6	9.1	4	422
No HI Parent	7.2	9.2	3	4291
Overall	7.2	9.2	3	4713

Note: $\text{Eta}^2 = <.01$. No Statistically significant difference between the means, $F(1,4711) = .76$, $p \leq .05$.

Identification-to-Program-Start-Time-Interval Summary

1. The median identification-to-program-start interval was 4 months.
2. The median identification-to-program-start time interval was smallest (2.5 months) for children whose age at onset was two years or older.
3. The median identification-to-program-start time interval was largest (6 months) for children whose cause of loss was a syndrome and for children from homes in which international languages other than Spanish were spoken.

Suspicion-to-Program-Start Interval

The suspicion-to-program-start time interval was computed by subtracting the suspicion date from the program-start date and converting the difference into months. For 17% of the children (*N* = 856) an interval between suspicion and program start could not be calculated because one or both values were not reported.

The mean, standard deviation, and median intervals between suspicion and program start are provided in Table 85 for the children overall and for each program year. Discounting the 1979-80 program year, for which the sample size was exceptionally small, the median suspicion-to-program-start intervals ranged from 8 to 10 1/2 months, with an overall median of 9 months. The means were consistently larger than the medians, ranging from 10.8 to 15.3 months, with an overall mean interval of 12.7 months. The overall standard deviation (11.1) was used in the calculation of the *SMD*s in this section.

Table 85

Mean, Standard Deviation, and Median Intervals Between Age of Suspicion and Age at Program Start, Overall and by Program-Start Year

Program Year	M	SD	Mdn	N
7-1-79 thru 6-30-80	7.1	4.8	6	29
7-1-80 thru 6-30-81	10.8	9.5	8	115
7-1-81 thru 6-30-82	15.3	12.1	12	326
7-1-82 thru 6-30-83	13.6	11.1	10	471
7-1-83 thru 6-30-84	13.1	10.6	10.5	324
7-1-84 thru 6-30-85	11.9	9.8	9	343
7-1-85 thru 6-30-86	11.5	10.8	8	311
7-1-86 thru 6-30-87	13.0	11.8	9	445
7-1-87 thru 6-30-88	11.5	10.2	8	473
7-1-88 thru 6-30-89	12.6	10.9	9	505
7-1-89 thru 6-30-90	13.0	11.5	9.5	530
7-1-90 thru 6-30-91	12.6	11.7	8.5	450
Overall	12.7	11.1	9	4322

Note: Total children possible = 5,178.

Suspicion-to-program-start time interval by presence of other handicaps. The median suspicion-to-program-start time intervals for children with and without an additional handicapping condition were 10 and 9 months, respectively (Table 86). Although the difference between the mean intervals was statistically significant, the Eta^2 was practically nil and the actual mean difference was 1.4 months (SMD = .13), favoring children without an additional handicapping condition.

Table 86

Mean, Standard Deviation, and Median Intervals Between Suspicion and Program Start by Presence of Other Handicaps, 1979-1991

	M	SD	Mdn	N
Other Handicap Present	13.7	11.6	10	1029
No Other Handicap Present	12.3	10.8	9	3206
Overall	12.6	11.0	9	4235

Note: $Eta^2 = <.01$. Statistically significant difference between the mean ages, $F(1,4233) = 12.6$, $p \leq .05$.

Suspicion-to-program-start time interval by severity of hearing loss. The median differences among the suspicion-to-identification time intervals for the severity levels were small, ranging from 8 to 10 months (Table 87). Although the difference among the mean intervals was statistically significant, the Eta^2 was essentially zero (<.01). The largest actual mean difference between severity levels was only 1.9 months. The SMDs were small (ranging from .01 to .17) by Cohen's (1988) standards.

Table 87

Mean, Standard Deviation, and Median Intervals Between Suspicion to Program Start by Severity of Hearing Loss, 1979-1991

Severity	M	SD	Mdn	N
No Loss	12.9	10.9	10	142
Mild Loss	13.0	12.4	8	331
Moderate Loss	13.6	11.8	10	775
Severe Loss	12.3	10.7	9	1746
Profound Loss	11.7	10.0	9	883
Overall	12.5	11.0	9	3877

Note: $Eta^2 = <.01$. Statistically significant difference among the mean ages, $F(4,3872) = 3.3$, $p \leq .05$.

Suspicion-to-program-start time interval by cause of hearing loss. The causes of hearing loss provided in Table 88 are arranged by median from the smallest to the largest suspicion-to-program-start time intervals. The medians ranged from 7 months, for children for whom the cause of hearing loss was meningitis and drugs during pregnancy, to 13 months, for children for whom birth trauma and conditions during pregnancy were the causes of hearing loss. The overall median was 9 months.

A statistically significant difference among the mean suspicion-to-program-start time intervals was obtained; however, the Eta^2 was small (.02). Again, children were removed from the analysis for whom the cause of loss was unknown, not reported, or reported as "other." Post-hoc analyses indicated that the mean suspicion-to-program-start interval for children whose cause of loss was meningitis was statistically significantly smaller than the mean intervals for children whose cause of hearing loss was birth trauma, defects at birth, or conditions during pregnancy. The mean intervals ranged from 10.7 months, for children who had contracted meningitis, to 16.3 months, for child who had suffered birth trauma--that is, the largest mean difference was 5.6 months. The SMDs ranged from small to medium (.01 to .50) by Cohen's (1988) standards.

Table 88

Mean, Standard Deviation, and Median Intervals Between Suspicion and Program Start by Cause of Hearing Loss, 1979-1991

Cause	M	SD	Mdn	N
Meningitis	10.7	10.5	7	545
Drugs During Pregnancy	13.0	13.0	7	21
Rh Incompatibility/Kernicterus	13.2	12.0	8.5	32
Unknown Cause *	12.3	10.4	9	2026
Heredity	12.7	10.8	9	450
Drugs Given to Child	13.4	13.1	9.5	40
Middle-Ear Problems	12.8	11.1	10	205
Rubella/CMV	13.6	12.7	10	143
Child Syndrome	13.9	11.6	10	125
Cause Not Reported *	14.5	12.7	10	66
Other Cause *	14.0	11.1	11	82
Defects at Birth	14.9	13.2	11	221
Fever or Infection in Child	14.2	11.3	12.5	104
Conditions During Pregnancy	14.4	10.8	13	141
Birth Trauma	16.3	13.1	13	121
Overall	12.7	11.1	9	4322

Note: $Eta^2 = .02$. Statistically significant difference among the mean ages, for known causes of hearing loss, $F(11,2136) = 3.9$, $p \leq .05$.
* Not included in analysis.

Suspicion-to-program-start time interval by age at onset of loss. For the five levels of age at onset, the median suspicion-to-program-start time intervals ranged from 5 months, for children with age at onset of one to two years, to 10 months, for children with age at onset at birth or at birth to one year (Table 89). Although a statistically significant difference among the mean intervals was obtained, the Eta^2 was small (.02). Post-hoc analyses indicated that the mean suspicion-to-program-start intervals for children whose age at onset was at birth and at birth to one year was statistically significantly larger than the mean intervals for children whose age at onset was one to two and two to three years. The mean intervals ranged from 7.2 months to 13.8 months, with the SMDs ranging from small to medium (.04 to .59) by Cohen's (1988) standards.

Table 89

Mean, Standard Deviation, and Median Intervals Between Suspicion to Program Start by Age at Onset of Hearing Loss, 1979-1991

Age at Onset	M	SD	Mdn	N
At Birth	13.8	11.8	10	1358
Birth to 1 Year	13.1	11.9	10	271
1 to 2 Years	9.1	9.3	5	193
2 to 3 Years	7.2	6.5	6	57
3 Years or Older	9.5	13.5	6	18
Overall	13.0	11.6	9	1897

Note: $Eta^2 = .02$. Statistically significant difference among the mean ages, $F(4,1892) = 11.1$, $p \leq .05$.

Suspicion-to-program-start time interval by language spoken in the home. The median suspicion-to-program-start time intervals for the levels of language spoken in the home ranged from 8 to 13 months (Table 90). No statistically significant difference among the mean intervals was obtained, and Eta^2 was essentially zero (<.01). The mean intervals ranged from 11.5 to 15.1 months. The largest difference between pairs of means was 3.6 months. The SMDs were small (ranging from .01 to .32) by Cohen's (1988) standards.

Suspicion-to-program-start time interval by parental hearing loss. The median suspicion-to-program-start time intervals for children with and without a parent with a hearing loss were 10 and 9 months, respectively (Table 91). No statistically significant difference between the mean intervals was obtained, and Eta^2 was essentially zero (<.01). The mean suspicion-to-program-start interval for children with a hearing-impaired parent was 13.3 months, compared to 12.6 months for children without a hearing-impaired parent (SMD = .06).

Table 90

Mean, Standard Deviation, and Median Intervals Between Suspicion and Program Start by Language Spoken in the Home, 1979-1991

Language	*M*	*SD*	*Mdn*	*N*
English	12.7	11.0	9	3842
Spanish	13.2	11.7	9	213
ASL	11.5	9.1	9	111
Signed English	13.1	11.7	8	45
Other	15.1	12.8	13	59
Overall	12.7	11.1	9	4270

Note: Eta^2 = <.01. No Statistically significant difference among the means, *F*(4,4265) = 1.2, *p* = .32.

Table 91

Mean, Standard Deviation, and Median Intervals Between Suspicion and Program Start by One or More Hearing-Impaired Parent, 1979-1991

Parental Hearing Loss	*M*	*SD*	*Mdn*	*N*
One or More HI Parent	13.3	11.3	10	374
No HI Parent	12.6	11.0	9	3887
Overall	12.7	11.0	9	4261

Note: Eta^2 = <.01. No Statistically significant difference between the means, *F*(1,4259) = 1.4, *p* = .24.

Suspicion-to-Program-Start-Time-Interval Summary

1. Overall, the median suspicion-to-program-start time interval was 9 months.
2. The median suspicion-to-program-start interval was smallest (i.e., 5 to 6 months) for children whose age at onset was one year or older.
3. The median suspicion-to-program-start time interval was largest (13 months) for children from homes in which languages other than

Spanish were spoken.

4. The median suspicion-to-program-start interval was largest (13 months) for children whose cause of hearing loss was conditions during pregnancy (e.g., prematurity) and birth trauma.

Who Suspected the Hearing Loss and Cause of Suspicion

As described in the previous section, the median identification age was 17 months. With a median suspicion-to-identification time interval of 3 months, at least 50% of the children were first suspected between birth and 14 months of age to have a hearing loss. When developing the identification-procedure questionnaire (Appendix E), two questions were of particular interest: (a) Who first suspected the hearing loss? and (b) What caused the suspicion? We present in this section the findings from the questionnaire for these two questions. Personnel from 65 sites volunteered to participate in this portion of the study (Table 46). Site personnel were instructed to obtain the responses to each question from the children's files but also to telephone parents if the required information was not available in the files. Data were submitted for 1,404 children, for the program years 1986-1989 only.

Who Suspected the Hearing Loss

As expected, the findings from the questionnaire indicated that caregivers (e.g., parents, grandparents, baby sitters) were the first to suspect a hearing loss for nearly 60% (*N* = 835) of the children (Table 92). For 12% (*N* = 170) of the children, medical personnel were the first to suspect a hearing loss. Educators, other specialists (audiologists, speech-language pathologists, and psychologists), and health and human services personnel accounted for the remaining 7% (*N* = 101) of the children. For 21% (*N* = 298) of the children, the response to this question was "unknown" or there was no response to the question.

Table 92

Frequencies and Percentages of Children by Who Suspected the Hearing Loss, 1986-1989

Who Suspected	N	%
Caregivers	835	59.5
Medical Personnel	170	12.1
Educators	51	3.6
Other Specialists	34	2.4
Health Dept./Human Services	16	1.1
No Response/Unknown	298	21.2
Total	1404	100.0

In Table 93, we present the means, standard deviations, and medians for each of the age and time-interval variables by the categories of who first suspected a hearing loss. Findings from the analyses of variance are reported also, as wel as the Eta^2 values, which were all small, indicating little relationship between the age and time-interval variables and the categories of who suspected the hearing loss. For all analyses, the No Response/Unknown category was not included.

Identification age. The median identification ages ranged from 11 months, for children whose hearing losses were first suspected by health and human services personnel, to 24 months, for those suspected by educators. The difference among the mean identification ages was statistically significant, with the means ranging from 13.4 months to 27.3 months. The SMDs ranged from small to large (.04 to 1.07) by Cohen's (1988) standards. Post-hoc analyses indicated that children whose hearing loss was suspected by health/human services personnel, medical personnel, or caregivers obtained statistically significantly lower mean identification ages than those suspected by educators. Because children typically do not attend preschool until approximately 2 1/2 to 3 years of age, this finding was anticipated.

Table 93

Means, Medians, Standard Deviations, and ANOVA Results for Ages and Time Intervals by Who Suspected the Hearing Loss, 1986-1989

Who Suspected	Mean	Mdn	SD	N	F	Eta^2
Age of Identification (in Months)						
Health/Human Services	13.4	[11]	7.9	16	9.3*	.04
No Response/Unknown	15.4	[13]	12.1	282		
Medical	15.9	[14.5]	12.1	166		
Caregivers	20.0	[18]	12.5	803		
Other Specialists	20.5	[17]	15.7	32		
Educators	27.3	[24]	16.9	50		
Age at Program Start (in Months)						
Health/Human Services	19.2	[15.5]	10.1	16	6.6*	.02
Medical	23.4	[22]	13.3	168		
No Response/Unknown	24.3	[23]	14.4	293		
Caregiver	26.5	[25]	13.0	822		
Other Specialists	28.5	[24]	17.4	32		
Educators	33.1	[31]	17.3	50		
Age Hearing Aid Fit						
Health/Human Services	7.2	[15.5]	9.0	8	6.4*	.03
No Response/Unknown	21.2	[19]	12.0	226		
Medical	22.7	[21]	13.2	134		
Caregivers	24.8	[24]	12.9	721		
Other Specialists	29.2	[23]	18.0	26		
Educators	33.2	[31]	15.6	41		
Time Interval (in Months) Between Suspicion and Identification						
Medical	3.1	[1]	6	161	5.2*	.02
Health/Human Services	4.1	[2.5]	4.2	16		
No Response/Unknown	4.1	[2]	6.6	264		
Educators	5.5	[2]	8.1	49		
Caregivers	6.1	[3]	7.9	758		
Other Specialists	6.7	[3]	9.3	31		
Time Interval (in Months) Between Identification and Program Start						
Health/Human Services	5.8	[4]	5.8	16	.9	<.01
Educators	5.8	[3]	8.1	50		
Caregivers	6.2	[3]	8.3	798		
Medical	7.4	[4]	9.1	166		
Other Specialists	7.9	[2.5]	14.9	32		
No Response/Unknown	8.3	[4]	9.8	282		

Table 93 (Continued)

Who Suspected	Means	Mdn	SD	N	F	Eta²
Time Interval (in Months) Between Suspicion and Program Start						
Health/Human Services	9.9	[7.5]	7.4	16	1.5	.01
Medical	10.4	[7]	10.4	155		
Educators	11.4	[9]	11.6	49		
No Response/Unknown	12.2	[8]	10.9	263		
Caregivers	12.2	[9]	10.6	751		
Other Specialists	14.8	[9]	15.3	31		

Note: * = Statistically significant difference among the means, $p \leq .05$.
Medians are in brackets.

Program-start age. The median program-start ages ranged from 15.5 months for children whose hearing losses were first suspected health and human services personnel, to 31 months, for those suspected by educators. The difference among the mean program-start ages was statistically significant, with the means ranging from 19.2 months to 33.1 months. The SMDs ranged from small to large (.07 to 1.03) by Cohen's (1988) standards. Again, post hoc analyses indicated that children whose hearing losses were first suspected by health/human services personnel, medical personnel, and caregivers obtained statistically significantly lower mean program-start ages than those suspected by educators.

Hearing-aid-fit age. The median hearing-aid-fit ages ranged from 15.5 months, for children whose hearing losses were first suspected by health and human services personnel, to 31 months, for those suspected by educators. The difference among the mean hearing-aid-fit ages was statistically significant, with the means ranging from 17.2 months to 33.2 months. The SMDs ranged from small to large (.11 to 1.2) by Cohen's (1988) standards. Again, post hoc analyses indicated that children whose hearing losses were suspected by health/human services personnel, medical personnel, or caregivers obtained statistically significantly lower mean hearing-aid fit ages than those suspected by educators.

Suspicion-to-identification time interval. The median suspicion-to-identification time intervals ranged from one month, for children whose hearing losses were suspected by medical personnel, to three months, for those suspected by caregivers and other specialists. The difference among the mean suspicion-to-identification intervals was statistically significant, with the means ranging from 3.1 months to 6.7 months. The SMDs ranged from nil to small (.00 to .47) by Cohen's (1988) standards. Post-hoc analyses indicated that children whose hearing losses were suspected by medical personnel obtained statistically significantly lower mean suspicion-to-identification time intervals than those suspected by caregivers.

Identification-to-program-start time interval. The median identification-to-program-start time intervals ranged from 2.5 months, for children whose hearing losses were suspected by other specialists, to 4 months, for those suspected by health and human services personnel and medical personnel. The difference among the mean identification-to-program-start intervals was not statistically significant, with the means ranging from 5.8 months to 8.3 months. The SMDs ranged from nil to small (.00 to .29) by Cohen's (1988) standards.

Suspicion-to-program-start time interval. The median suspicion-to-program-start time intervals ranged from 7 months, for children whose hearing losses were suspected by medical personnel, to 9 months, for those suspected by caregivers, educators, and other specialists. The difference among the mean suspicion-to-program-start intervals was not statistically significant, with the means ranging from 9.9 months to 14.8 months. The SMDs were small (ranging from .05 to .45) by Cohen's (1988) standards.

What Caused the Suspicion

As expected, the findings from the questionnaire indicated that delays in auditory and language development caused suspicion of a hearing loss for 55.3% (N = 777) of the children (Table 94). Heredity and meningitis were each cause for suspicion for 5.1% (N = 72) of the children. A variety of other causes of suspicion accounted for the remaining 10.6% (N = 148) of the children (see Table 94). For 23.9% (N = 335) of the children, cause of suspicion was reported as unknown or there was no response to this question.

Table 94

Frequencies and Percentages of Children for Each Cause of Suspicion, 1986-1989

Cause of Suspicion	N	%
Auditory or Language Delay	777	55.3
Heredity	72	5.1
Meningitis	72	5.1
Birth Complications/Defects	64	4.6
Otitis Media/Middle Ear	27	1.9
Medical/School Screening	19	1.4
ADD/Behavior Problem	13	.9
Health Problems	11	.8
Rubella/CMV	11	.8
High-Risk Register Card	3	.2
No Response/Unknown	335	23.9
Total	1404	100.0

In Table 95, we present the mean, standard deviation, and median identification ages for each cause of suspicion. Findings from the analysis of variance are reported also, as well as the Eta^2 value. For 17% (N = 235) of the children either no identification age was reported or the cause of suspicion was not reported or was reported as unknown.

The median identification ages ranged from 3 months, for children whose hearing loss was suspected because of rubella/CMV, to 25 months, for those suspected because of behavior problems/attention-deficit disorder (ADD). The difference among the mean identification ages was statistically significant, with the means ranging from 8.2 months, for children with rubella/CMV as a cause of suspicion, to 28 months, for children with ADD/behavior problems. The SMDs ranged from small to large (.04 to 1.52) by Cohen's (1988) standards.

Table 95

Frequencies and Percentages of Children and Mean, Standard Deviation, and Median Age of Identification for Each Cause of Suspicion

	Age of ID			
Cause of Suspicion	M	SD	Mdn	N
Auditory or Language Delay	21.5	12.7	20	743
Heredity	10.6	10.6	7	72
Meningitis	18.5	10.7	17	71
Birth Complications/Defects	10.4	10.4	8.5	62
Otitis Media/Middle Ear	20.2	12.3	18	27
Medical/School Screening	23.6	17.6	18	17
ADD/Behavior Problem	28.0	15.0	25	13
Health Problems	16.0	14.0	14	11
Rubella/CMV	8.2	10.3	3	11
High-Risk Register Card	20.7	28.0	5	3
Total				1169

Note: Total children possible = 1,404. $Eta^2 = .10$. Statistically significant difference among the mean ages, $F(9,1020) = 11.9$, $p \leq .05$.

Post-hoc analyses indicated that children with rubella/CMV, heredity, or birth complications/defects as causes of suspicion obtained statistically significantly lower mean identification ages than children with ADD/behavior problems, medical/school screenings, or auditory/language delays.

Who Suspected and Cause-of-Suspicion Summary

A brief summary of the major findings regarding who first suspected a hearing loss and what caused the suspicion is provided below:

1. The majority of the hearing losses (60%) were first suspected by caregivers.
2. Earliest identification ages, program-start ages, and hearing-aid-fit ages were associated with health/human services and medical personnel.
3. The shortest time intervals between suspicion and identification were associated with medical and health/human services personnel.

4. The median time interval from identification to program start was shortest for other specialists--85% of whom were audiologists.

Identification Procedures

The primary goals of the identification-procedure portion of this investigation were to determine (a) how the children were identified as hearing impaired and (b) the relationships between the identification procedures and the age and time-interval variables. Again, the findings for these questions were obtained from the identification-procedure questionnaire (Appendix E). Site personnel were asked the following three questions for each child: (a) Was the child born in a hospital in which a high-risk register is completed for each child? (b) Did this child spend time in an NICU [Neonatal Intensive Care Unit] after birth? and (c) Did a formal, infant hearing-screening program provide the first indication that the child possibly had a hearing impairment?" If the answer was yes to the third question, site personnel were instructed to circle one of the following options: Crib-O-Gram, Otoacoustic Emission Screening, Middle-ear (Immittance/Impedance) Screening, Behavioral Audiometry Screening, ABR Screening, or Other. If the answer was no to the third question, site personnel were asked to specify who referred the child for audiological testing and what caused the individual to suspect that the child had a hearing impairment.

High-Risk Register

For 23% (N = 319) of the children, site personnel responded yes to the first question. Of those 319 children, site personnel indicated that for 76% of them (N = 243), identification of hearing loss occurred because some individual (namely caregiver, medical personnel, health/human services personnel, educator, and other specialist) suspected a hearing loss. Also, for 58% of these 319 children (N =184), the cause of suspicion of hearing loss was language delay or lack of auditory responsiveness. For only 3 of the children was a high-risk notification listed as the cause of suspicion of hearing loss.

With 319 children born in hospitals with high-risk-register systems in place and with a finding that only three children were identified through the high-risk notification system, we conjectured that documentation was not included in the site files for the children whose parents received a high-risk notice. To examine this issue more closely, we looked at the age of identification for Utah, which has had a well-established statewide high-risk-register system in place since 1978, as compared to SKI*HI overall. In the Utah system, the parents complete a high-risk questionnaire at the same time that they complete the birth certificate application for their child. If the parents respond affirmatively to any of the high-risk factors, they are notified by mail three to four months after their child's birth and given a number to call if they are concerned about their child's hearing. Follow-up is through the State Department of Health.

Figure 4 provides the median identification ages by four-month blocks for Utah as compared to SKI*HI overall. A striking difference between the two broken curves in seen before 12 months of age, with 18.5% of the children in Utah being identified by 4 months of age as compared to 12.2% of the children for SKI*HI overall. By 8 months of age, cumulatively, 29% of the children in Utah had been identified as compared to 21.8% for SKI*HI overall. Although we have no documentation that such a large percentage of the Utah children had been identified early because of the high-risk-register-notification system, the graph provides compelling support for that interpretation.

NICU

For 14% (N = 199) of the children, site personnel responded yes to the second question--that is, that the children had spent time in a neonatal intensive care unit after birth. For 44% of those 199 children (n = 87), site personnel indicated ABR testing had first indicated a hearing loss (M age of identification = 12.3 months, sd = 11.2, median = 9 months). For 46% (n = 92) of the children, hearing loss was identified because of some individual's suspicion (M age of identification = 15.4 months, sd = 10.9, median = 13 months). Clearly, ABR testing decreased the median identification age by four months.

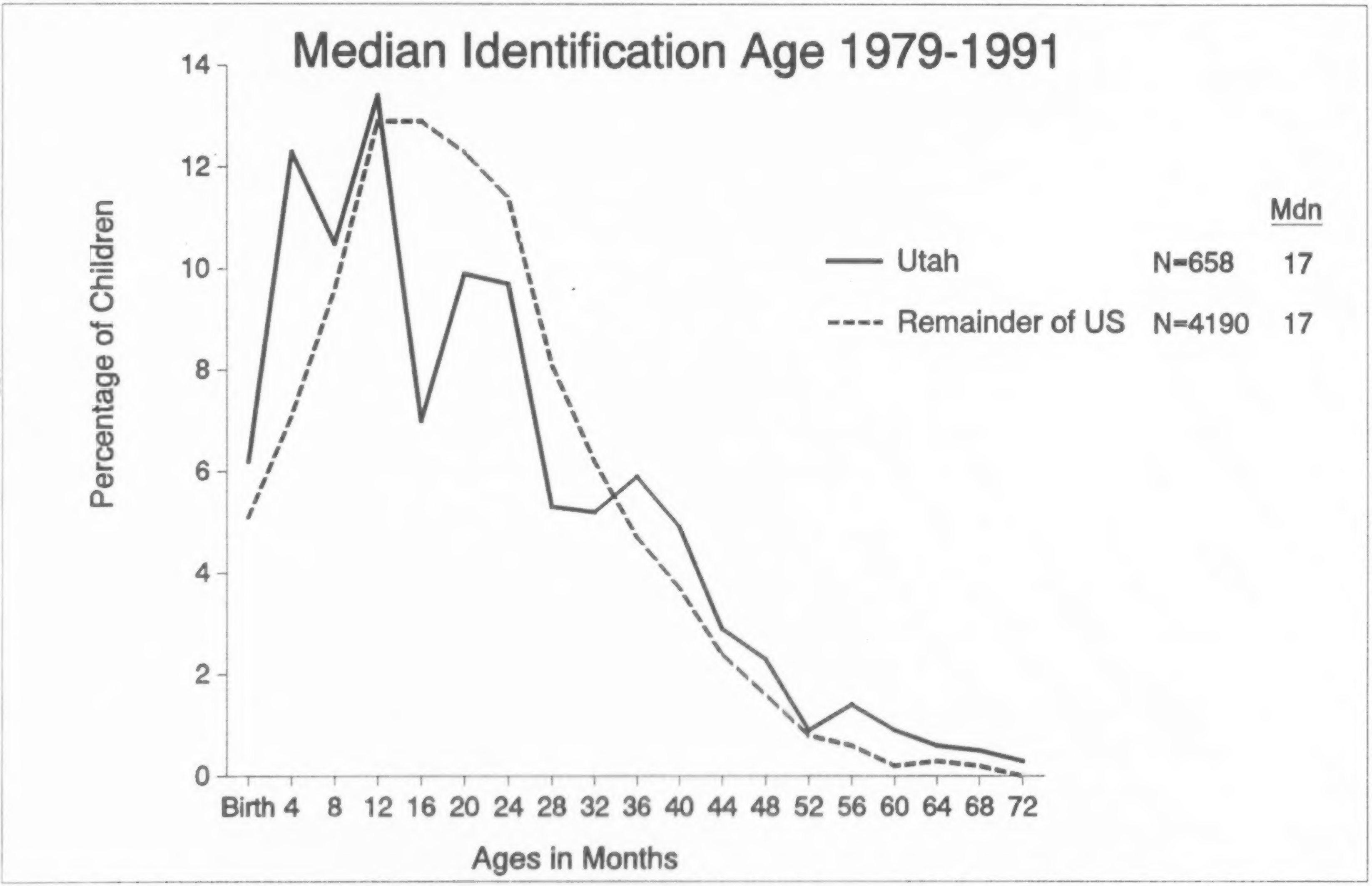

Figure 4. Median ages of identification by four-month age blocks for Utah and SKI*HI overall, 1979-1991.

Relative Frequencies for Each Identification Procedures

A summary of the responses to the third question asked of the site personnel is now provided. As expected, people (caregivers, medical personnel, educators, health/human services personnel, and other specialists) who suspected a hearing loss were the primary means by which the children were initially identified as hearing impaired (78.8%, N = 1106, Table 96). For 10.8% (N = 152) of the children, an ABR screening was the initial means by which the children were identified. Behavioral audiometry, middle ear/immittance, and Crib-O-Gram were the initial screening procedures for the remaining 3.1% (N = 44) of the children. For 7.3% (N = 102) of the children, the response was "unknown" or there was no response to the question.

Table 96

Frequencies and Percentages of Children by Identification Procedure, 1986-1989

ID Procedure	N	%
People	1106	78.8
ABR	152	10.8
Behavioral Audiometry	31	2.2
Middle Ear/Immittance	7	.5
Crib-O-Gram	6	.4
No Response/Unknown	102	7.3
Total	1404	100.0

Whether children were referred by the screening agency. Of interest, too, was whether the children were referred by the screening agency. The data in Table 97 indicate that of the 196 children who were identified through a formal infant hearing-screening program, 81% (N = 158) were referred to the parent/infant program by the screening agency, leaving 19% (N = 38) not referred by the screening agency.

Type of referring agency. The types of referring agencies are also provided in Table 97, along with their relative frequencies of occurrence. Approximately 68% of the referrals to the parent/infant program came through medical and audiology/speech pathology agencies.

Table 97

Frequencies and Percentages of Children Referred to Home-Programming by Formal Infant Screening Program and Type of Referring Agency

	N	%
	Referred	
Yes	158	81
No	38	19
Total	196	100
	Type of Referring Agency	
Medical	75	38.5
Aud/Speech Pathology	58	29.7
Educational	34	17.4
Health/Human Service	15	7.7
Parents	4	2.1
Not Reported	10	4.6
Total	196	100.0

Ages and Time Intervals

In Table 98, we present the means, standard deviations, and medians for each of the age and time-interval variables by the identification procedures. Findings from the analyses of variance are reported also, as well as the Eta^2 values, which were all small, indicating little relationship between the age and time-interval variables and the identification-procedure categories. Care should be taken in interpreting these findings because of the small sample sizes for Crib-O-Gram and middle-ear/immittance procedures.

Identification age. The median identification ages ranged from 6 months, for children identified by Crib-O-Gram, to 26 months, for children identified

Table 98

Means, Medians, Standard Deviations, and ANOVA Results for Ages and Time Intervals by Identification Procedures, 1986-1989

ID Procedure	Mean	Mdn	SD	N	F	Eta^2
Age of Identification (in Months)						
Crib-O-Gram	8.3	[6]	9.1	6	13.8*	.04
ABR	12.1	[10]	10.8	148		
Suspected by People	19.6	[18]	13.0	1067		
Behavior Audiometry	20.7	[19]	13.0	30		
Immittance	29.1	[26]	9.3	7		
Age at Program Start (in Months)						
ABR	20.1	[17]	12.9	150	7.8*	.02
Crib-O-Gram	24.0	[26]	5.4	6		
Suspected by People	26.3	[25]	13.5	1088		
Behavior Audiometry	28.9	[27]	15.1	31		
Immittance	32.0	[31]	8.6	7		
Age Hearing Aid Fit						
Crib-O-Gram	16.3	[15]	6.6	6	6.3*	.02
ABR	19.3	[17.5]	11.6	124		
Suspected by People	24.9	[24]	13.3	930		
Behavior Audiometry	27.1	[24]	13.1	26		
Immittance	30.8	[27]	10.6	5		

Table 98 (Continued)

ID Procedure	Means	Mdn	SD	N	F	Eta^2
Time Interval (in Months) Between Suspicion and Identification						
Immittance	1.1	[1]	1.1	7	2.8*	.01
ABR	3.6	[1]	6.6	142		
Crib-O-Gram	4.2	[4.5]	3.9	6		
Behavior Audiometry	5.2	[2]	6.2	29		
Suspected by People	5.6	[3]	7.7	1015		
Time Interval (in Months) Between Identification and Program Start						
Immittance	2.9	[2]	2.0	7	3.3*	.01
Suspected by People	6.4	[3]	8.6	1062		
ABR	7.9	[4]	9.6	148		
Behavior Audiometry	9.0	[5]	11.9	30		
Crib-O-Gram	15.7	[16]	9.3	6		
Time Interval (in Months) Between Suspicion and Program Start						
Immittance	4.0	[3]	2.4	7	2.2	.01
ABR	11.4	[7.5]	10.9	142		
Suspected by People	12.0	[8]	10.8	1007		
Behavior Audiometry	14.3	[11]	13.0	29		
Crib-O-Gram	19.8	[20]	6.6	6		

Note * = Statistically significant difference among the means, $p \leq .05$. Medians are in brackets.

by middle-ear/immittance procedures. The difference among the mean identification ages was statistically significant, with the means ranging from 8.3 months to 29.1 months. The SMDs ranged from small to large (.09 to 1.6) by Cohen's (1988) standards. Post-hoc analyses indicated that children identified by ABR obtained a statistically significantly lower mean identification age than children identified by behavioral audiometry or middle-ear/immittance procedures.

Program-start age. The median program-start ages ranged from 17 months, for children identified by ABR, to 31 months, for children identified by immittance. The difference among the mean program-start ages was statistically significant, with the means ranging from 20.1 months to 32 months. The SMDs ranged from small to large (.17 to .88) by Cohen's (1988) standards. Post-hoc analyses indicated that children identified by ABR obtained a statistically significantly lower mean program-start age than children identified by behavioral audiometry.

Hearing-aid-fit age. The median hearing-aid-fit ages ranged from 15 months, for children identified by Crib-O-Gram, to 27 months, for children identified by middle-ear/immittance procedures. The difference among the mean hearing-aid-fit ages was statistically significant, with the means ranging from 16.3 months to 30.8 months. The SMDs ranged from small to large (.17 to 1.1) by Cohen's (1988) standards. Post-hoc analyses indicated that children identified by ABR obtained a statistically significantly lower mean hearing-aid-fit age than children identified by behavioral audiometry.

Suspicion-to-identification time interval. The median suspicion-to-identification time intervals ranged from one month, for children identified by ABR and middle-ear/immittance procedures, to 4.5 months, for children identified by Crib-O-Gram. The difference among the mean suspicion-to-identification intervals was statistically significant, with the means ranging from 1.1 months to 5.6 months. The SMDs ranged from small to medium (.05 to .60) by Cohen's (1988) standards. Post-hoc analyses indicated that children identified by ABR obtained statistically significantly smaller mean suspicion-to-identification time intervals than children identified by people.

Identification-to-program-start time interval. The median identification-to-program-start time intervals ranged from 2 months, for children identified by middle-ear/immittance procedures, to 16 months, for children identified by Crib-O-Gram. The difference among the mean identification-to-program-start intervals was statistically significant, with the means ranging from 2.9 months to 15.7 months. The SMDs ranged from small to large (.17 to 1.4) by Cohen's (1988) standards. Although the overall *F* was statistically significant, post-hoc analyses indicated that no two means were statistically significantly different from one another.

Suspicion-to-program-start time interval. The median suspicion-to-program-start time intervals ranged from 3 months, for children identified by middle-ear/immittance procedures, to 20 months, for children identified by Crib-O-Gram. The difference among the mean suspicion-to-program-start intervals was not statistically significant, with the means ranging from 4 months to 19.8 months. The SMDs were small to large (ranging from .05 to 1.5) by Cohen's (1988) standards.

Summary

A summary of the major findings for the identification procedures follows:

1. The majority of the children were identified by people (caregivers, medical and health/human services personnel, educators, and other specialists) as compared to screening procedures using behavioral audiometry, ABR, Crib-O-Gram, or middle ear/immittance.
2. Although no direct documentation was obtained, indirect evidence indicates that for Utah children, the high-risk register may have accounted for the large percentage of children who were identified by four to eight months of age.
3. Sample sizes were extremely small for the Crib-O-Gram, behavior audiometry, and middle-ear/immittance

identification procedures. Consequently, no conclusive evidence can be presented regarding which procedures resulted in the youngest identification, program-start, and hearing-aid-fit ages or the smallest suspicion-to-identification, identification-to-program-start, and suspicion-to-program-start time intervals.

Relationships Among the Age and Time-Interval Variables

Correlation Coefficients

The correlation coefficients describing the magnitude and direction of the relationships among the ages and time-intervals are presented in Table 99 for the identification-procedure study. Because the sample size was large, all coefficients were statistically significant. Not surprisingly, large positive coefficients were obtained describing the relationships between identification age and program-start age (r = .77), between identification age and hearing-aid-fit age (r = .84), and between program-start age and hearing-aid-fit age (r = .84). Also not surprising, moderate, positive coefficients were obtained describing the relationships between the suspicion-to-program-start interval and the suspicion-to-identification interval (r = .58), between the identification-to-program-start interval and the suspicion-to-program-start interval (r = .72), and between program-start age and suspicion-to-program-start interval (r = .55).

Correlation coefficients were computed for SKI*HI children overall. These data are presented in Table 100. In all cases, the coefficients were similar to those presented for the identification-procedure study.

Table 99

Correlation Coefficients for Identification-Procedure Study, 1986-1989

	Age of Id	Age Program Start	Age Hearing Aid Fit	Time Between Suspicion and ID	Time Between ID and Program Start
Age Program Start	.77*				
Age Hearing Aid Fit	.84*	.84*			
Time Between Suspicion and ID	.44*	.32*	.35*		
Time Between ID and Program Start	-.27*	.40*	.06*	-.14*	
Time Between Suspicion and Program Start	.07*	.55*	.28*	.58*	.72*

Note: *Statistically significant, $p \leq .01$. Minimum pairwise N of cases: 904.

Table 100

Correlation Coefficients for SKI*HI Overall, 1979-1991

	Age of Id	Age Program Start	Age Hearing Aid Fit	Time Between Suspicion and ID	Time Between ID and Placement
Age Program Start	.77*				
Age Hearing Aid Fit	.87*	.81*			
Time Between Suspicion and ID	.44*	.34*	.39*		
Time Between ID and Program Placement	-.24*	.43*	.04*	-.11*	
Time Between Suspicion and Program Placement	.11*	.58*	.29*	.58*	.74*

Note: *Statistically significant, $p \leq .01$. Minimum pairwise N of cases: 2713.

Predicting Pretest Language Quotients

The final question to be addressed in this chapter is which combination of age and time-interval variables best predicts pretest expressive and receptive language quotients. Please note that posttest quotients or scores will be discussed in the following chapter. A quotient is a ratio of language age to chronological age times 100. Quotients of 100 indicate that language age and chronological age are equal; quotients of 50, for example, indicate that language age is half of the chronological age. The findings should be interpreted with caution because of the extremely small sample sizes for Crib-O-Gram and middle-ear/immittance procedures.

Descriptive Statistics for Expressive and Receptive Language Quotients

We present in Table 101 the mean, standard deviation, and median expressive and receptive language quotients by identification-procedure. The median expressive language quotients ranged from 24, for children identified by middle-ear/immittance procedures, to 60, for children identified by Crib-O-Gram. The median pretest receptive language quotients ranged from 29, for children identified by middle-ear/immittance procedures, to 70, for children identified by Crib-O-Gram. No statistically significant differences among the mean pretest quotients were obtained for either the expressive or receptive scales of the LDS, with the mean quotients ranging from 50 to 63.2 and from 48 to 67.3, respectively.

Multiple Regression

Correlation coefficients between each of the age and time-interval variables and the pretest expressive- and receptive-language quotients were computed. All coefficients were small and negative ($\underline{r}$ ranged from -.06 to -.19). Given the small coefficients, the findings from the multiple-regression analysis are not surprising. With all age and time-interval variables included in the equations, the multiple $\underline{R}$s for predicting both the expressive and receptive pretest quotients were low ($\underline{R}$ = .20 and .21, respectively). Using a stepwise-regression procedure, only program-start-age was included in both equations as an independent variable; the beta coefficients were -.20 and -.21 for the expressive and receptive scales, respectively. With the small zero-order $\underline{r}$s, the other age and time-interval variables were not included in the final equations for predicting pretest expressive and receptive language quotients.

Table 101

Means, Medians, Standard Deviations, and ANOVA Results for Expressive and Receptive Pretest Developmental Quotients by Identification Procedure, 1986-1989

ID Procedure	Means	Medians	Standard Deviation	N	F
		Expressive Language Quotients			
Behavioral Audiometry	53.6	52	20.5	24	1.65
People Suspected	56.5	53	27.7	838	
Crib-O-Gram	56.7	60	28.0	5	
Middle Ear	50.0	24	45.1	3	
ABR	63.2	54	32.1	118	
		Receptive Language Quotients			
Middle Ear	48.0	29	45.7	3	1.08
Behavioral Audiometry	60.0	64	18.4	24	
People Suspected	61.4	57	29.9	838	
Crib-O-Gram	67.3	70	34.2	5	
ABR	66.9	59	31.3	118	

Note: No statistically significant differences among the means, $p \leq .05$.
Based on total children possible of 1,404.

Summary

The major findings for this section are:

1. Mean pretest expressive and receptive language quotients were low for the identification procedures. Because sample sizes were small for two of the procedures, findings must be interpreted with caution.
2. No strong, or even moderate, coefficients were obtained describing the relationships among the ages and time-intervals and pretest receptive and expressive language quotients.
3. Findings from the multiple-regression analysis indicated that only program-start age predicted pretest expressive and receptive language quotients, any then only to a small degree (R = .20 and .21, respectively).

Summary

Some findings from this chapter will be highlighted here:

1. Overall, the median identification age was 17 months, with a median hearing-aid fit age of 22 months and a median program-start age of 25 months.
2. For children with additional handicapping conditions, the median identification age was 12 months, with a median hearing-aid fit age of 19 months and a median program-start age of 22 months.
3. For profoundly impaired children, the median identification age was 15 months, with a median hearing-aid-fit age of 19 months and a median program-start age of 21 months.
4. For children whose cause of hearing loss was a known risk factor or was visually apparent at birth, the median identification age ranged from 9 to 16.5 months; the median hearing-aid-fit age ranged from 17 to 19 months; and the median program-start-age ranged from 18 to 24 months.
5. For children whose age at onset was at birth or from birth to one year, the median identification age was 12 months, with a median hearing-aid-fit age of 18 months and a median program-start age of 21 months.
6. For children from homes in which ASL and signed English were the primary languages, the median identification ages were 8 and 13 months, respectively; the median hearing-aid-fit ages were 16 and 18.5 months, respectively; and the median program-start ages were 15 and 20.5 months, respectively.
7. For children with a hearing-impaired parent, the median identification age was 12 months, with a median hearing-aid-fit age of 19 months and a median program-start age of 21 months.
8. Overall, the median suspicion-to-identification time interval was 3 months, with a median identification-to-program-start interval of 4 months and a median suspicion-to-program-start interval of 9 months.

9. The median suspicion-to-identification time interval was smallest (1 month) for children whose cause of hearing loss was meningitis or defects at birth.

10. The median suspicion-to-identification time interval was also smallest (1 month), as was the median identification-to-program-start interval (2.5 months), for children whose age at onset was two years or older. The median suspicion-to-program-start interval was smallest (5 to 6 months) for children whose age at onset was one year or older.

11. The median identification-to-program-start time interval was largest (6 months) for children whose cause of loss was a syndrome.

12. The median identification-to-program-start time interval was also largest (6 months), as was the median suspicion-to-program-start time interval (13 months), for children from homes in which languages other than English and Spanish were spoken.

13. The median suspicion-to-program-start interval was largest (13 months) for children whose cause of hearing loss was conditions during pregnancy (e.g., prematurity) and birth trauma.

14. The majority of the hearing losses (60%) were first suspected by caregivers.

15. Earliest identification ages, program-start ages, and hearing-aid-fit ages were associated with health/human-services and medical personnel.

16. The shortest time intervals between suspicion and identification were associated with medical and health/human-services personnel.

17. The median time interval from identification to program start was shortest for other specialists--85% of whom were audiologists.

18. The majority of the children were identified by people (caregivers, medical and health/human-services personnel, educators, and other specialists) rather than by screening procedures using behavioral audiometry, ABR, Crib-O-Gram, or

middle ear/immittance.

19. Although no direct documentation was obtained, indirect evidence indicates that for Utah children, the high-risk register may have accounted for the large percentage of children who were identified by four to eight months of age.

20. Sample sizes were extremely small for the Crib-O-Gram, behavior audiometry, and middle-ear/immittance identification procedures. Consequently, no conclusive evidence can be presented regarding which procedures resulted in the youngest identification, program-start, and hearing-aid-fit ages or the smallest suspicion-to-identification, identification-to-program-start, and suspicion-to-program-start time intervals.

21. Using multiple-regression analyses, with all age and time-interval variables included in the procedure, only program-start age served as a predictor of pretest expressive and receptive language quotients. The multiple Rs were low.

The primary purpose of this chapter was to study the effectiveness of screening procedures for identifying hearing loss in neonates, infants, and young children. To set the context for the identification-procedure results, data describing each of the age and time-interval variables were presented, overall and by program year. In addition, data were presented describing relationships between each of the age and time-interval variables and the demographic variables that had been discussed in Chapter 5. In addition to descriptive and inferential statistics, correlation ratios, and effect sizes were presented to describe the magnitude of the relationships studied. Following these data, we presented the findings from the identification-procedure questionnaire, including data for the following: (a) who first suspected the hearing loss, (b) the cause of suspicion of a hearing loss, and (c) the identification procedures used. Finally, we described the relationships among all age and time-interval variables. One measure of the effectiveness of the SKI*HI model is whether children are identified early and the interval between identification and program start is brief. We have presented those findings and the conclusions are positive. Other measures of program effectiveness will be the topic of the chapter that follows.

CHAPTER 7

PROGRAM EFFECTIVENESS: THE RESULTS

The third major purpose of this investigation was to study the effectiveness of SKI*HI home-based programming, particularly the impact of treatment amount, treatment density, and program-start age on child language gains and developmental rates. Again, to set the context for studying program effectiveness, we present first in this chapter the descriptive statistics for each of the mediator variables, which include: treatment amount, planned and actual treatment density, communication methodology, communication-methodology age, program-start-to-communication-methodology interval, and other non-parent/infant-program services (see Figure 2). We also present data describing the relationships between the treatment variables (treatment amount and density and communication methodology) and specific demographic variables for which theoretically there could be an association (presence/absence of additional handicaps, severity of hearing loss, age at onset of loss, and presence/absence of hearing-impaired parent).

Following the descriptive information, we will present the program-effectiveness data, beginning with child data and using the SKI*HI Language Development Scale (LDS) receptive- and expressive-language scores. These data will include (a) mean pre-, post-, and predicted test scores, effect sizes, and PCIs for SKI*HI overall; (b) the ANOVA analyses of PCIs for each of the demographic and treatment variables; (c) value-added analysis (using regression analysis to calculate the amount of gain associated with effects other than maturation--the value added); and (d) the multiple-regression analysis, using treatment variables to predict posttest language developmental rate.

Next, we will present descriptive statistics for the child- and parent-outcome variables that were specifically related to the SKI*HI program goals (level of hearing-aid use, threshold improvement from amplification, auditory, communication-language, and vocabulary increases, and parent-skill acquisition). Finally, we will present the follow-up data that were collected for children who had been in the program from 1986-89 regarding program placement after SKI*HI and current program placement.

Mediator Variables

Treatment Amount

Treatment amount was calculated by subtracting the date of each child's last posttest from his/her program-start date and converting the difference into months. The mean and median treatment amounts for SKI*HI overall are provided in Table 102. The amounts ranged from 1 month to 78 months, with a mean of 14.8 months and median of 13 months. For 38% of the children (N = 1,947), the posttest date and/or program-start date were not reported, so treatment amount could not be calculated.

Table 102

Means, Standard Deviations, Medians, and Ranges for Treatment Amount, Treatment Density, and Gain Time (in Months)

	Overall				
Variable	M	SD	Mdn	Range	N
Amount	14.8	9.9	13	1-78	3231
Density	2.6	1.4	2.5	.1-15	1229
Gain Time	12.3	8.7	9	1-60	3259

Note: N = Sample Size.
Treatment Amount = time between program start and posttest, 1979-1991.
Density = actual number of visits per month, 1987-1991.
Gain Time = time between pretest and posttest (number of months of language gain), 1979-1991.

The same information can be viewed somewhat differently by inspecting the frequencies and percentages of children stratified by treatment amount in six-month age blocks (Table 103). Fifty-five percent of the children received treatment for 12 months or more. The relationships between treatment amount and five of the demographic variables were of interest. These data follow in this section.

Table 103

Frequencies and Percentages of Children by Treatment Amount, 1987-1991

Treatment Amount	N	%
0 to 6 months	466	14.4
6 to 12 Months	991	30.7
12 to 18 Months	720	22.3
18 to 24 Months	506	15.7
≥ 24 Months	548	17.0
Total	3231	100.0

Presence of other handicaps. The relationship between treatment amount and presence of other handicaps was practically nil (Cramer's *V* = .03). That is, the proportions within the cells were similar to expected proportions, based on the marginal values (Table 104), indicating that presence of other handicaps was not associated with treatment amount.

Table 104

Frequencies and Percentages of Children With/Without Additional Handicaps by Treatment Amount, 1979-1991

Treatment Amount	With Additional Handicap		No Additional Handicap		Overall	
	N	%	N	%	N	%
0 to 6 mos.	117	3.7	339	10.7	456	14.4
6 to 12 mos.	214	6.8	751	23.7	965	30.5
12 to 18 mos.	155	4.9	546	17.2	701	22.1
18 to 24 mos.	114	3.6	387	12.2	501	15.8
≥ 24 mos.	136	4.3	407	12.9	543	17.2
Overall	736	23.2	2430	76.8	3166	100.0

Note: Cramer's *V* = .03. Presence of other handicaps was not associated with treatment amount.

Severity of hearing loss. A low Cramer's V (.08) was obtained for the relationship between treatment amount and severity of hearing loss (Table 105). Only small differences separated obtained and expected percentages based on the marginal values, indicating that severity of hearing loss was not associated with amount of treatment.

Age at onset. Again, a low Cramer's V (.08) was obtained for the relationship between treatment amount and age at onset, with only small differences between obtained and expected percentages based on the marginal values (Table 106). Therefore, age at onset was not associated with amount of treatment.

Language spoken in the home. The relationship between treatment amount and language spoken in the home was also low (Cramer's V = .06), with the obtained percentages similar to those expected based on the marginal values (Table 107). Therefore, language spoken in the home was not associated with amount of treatment.

Parental hearing loss. Finally, the relationship between treatment amount and presence/absence of a parent with a hearing loss was low (Cramer's V = .07), with the obtained percentages similar to those expected based on the marginal values (Table 108). The conclusion was that the presence of parental hearing loss was not associated with amount of treatment.

Table 105

Frequencies and Percentages of Children by Severity and Treatment Amount, 1987-1991

Treatment Amount	No		Mild		Moderate		Severe		Profound		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
0 to 6 mos.	24	.8	42	1.4	91	3.1	175	5.9	87	2.9	419	14.1
6 to 12 mos.	44	1.5	91	3.1	199	6.7	391	13.2	165	5.6	890	30.0
12 to 18 mos.	21	.7	57	1.9	130	4.4	311	10.5	144	4.9	663	22.4
18 to 24 mos.	4	.1	33	1.1	88	3.0	236	8.0	118	4.0	479	16.2
≥ 24 mos.	7	.2	20	.7	87	2.9	236	8.0	163	5.5	513	17.3
Overall	100	3.4	243	8.2	595	20.1	1349	45.4	677	22.8	2964	100.0

Note: Cramer's V = .08. Severity of hearing loss was not associated with treatment amount.

Table 106

Frequencies and Percentages of Children by Treatment Amount and Age at Onset, 1979-1991

Treatment Amount	At Birth		Birth to 1 Year		1 to 2 Years		2 to 3 Years		3 Years or Greater		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
0 to 6 mos.	125	9.0	37	2.7	12	.9	5	.4	2	.1	181	13.0
6 to 12 mos.	276	19.8	50	3.6	53	3.8	14	1.0	1	.1	394	28.2
12 to 18 mos.	208	14.9	39	2.8	32	2.3	9	.6	2	.1	290	20.8
18 to 24 mos.	173	12.4	50	3.6	29	2.1	6	.4	0	.0	258	18.5
≥ 24 mos.	217	15.6	34	2.4	17	1.2	2	.1	2	.1	272	19.5
Overall	999	71.6	210	15.1	143	10.3	36	2.6	7	.5	1395	100.0

Note: Cramer's V = .08. Age at onset was not associated with treatment amount.

Table 107

Frequencies and Percentages of Children by Language Spoken in the Home and Treatment Amount, 1979-1991

Treatment Amount	English		ASL		Spanish		Signed English		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
0 to 6 mos.	417	13.1	10	.3	26	.8	6	.2	3	.1	462	14.5
6 to 12 mos.	890	27.9	18	.6	50	1.6	10	.3	11	.3	979	30.7
12 to 18 mos.	666	20.9	9	.3	25	.8	7	.2	8	.3	715	22.4
18 to 24 mos.	451	14.1	17	.5	19	.6	12	.4	4	.1	503	15.8
24 mos. or greater	467	14.6	29	.9	16	.5	7	.2	15	.5	534	16.7
Overall	2891	90.5	83	2.6	136	4.3	42	1.3	41	1.3	3193	100.0

Note: Cramer's V = .06. Language spoken in the home was not associated with treatment amount.

Table 108

Frequencies and Percentages of Children with a Hearing-Impaired Parent by Treatment Amount, 1979-1991

Treatment Amount	HI Parent		No HI Parent		Overall	
	N	%	N	%	N	%
0 to 6 mos.	39	1.2	419	13.2	458	14.4
6 to 12 mos.	78	2.4	901	28.3	979	30.7
12 to 18 mos.	48	1.5	661	20.7	709	22.3
18 to 24 mos.	40	1.3	463	14.5	503	15.8
24 mos. or greater	69	2.2	468	14.7	537	16.9
Overall	274	8.6	2912	91.4	3186	100.0

Note: Cramer's V = .07. Presence/absence of parental hearing loss was not associated with treatment amount.

Treatment Density

The number of home visits per week (i.e., treatment density) can be viewed from two perspectives: (a) scheduled (or planned) treatment density and (b) actual treatment density. On the SKI*HI Data Sheet, parent advisors indicate the scheduled frequency of home visits by placing a check mark in the appropriate blank (see Appendix A). Frequencies and percentages of children by scheduled frequency of home visits are provided in Table 109. For 4% of the children (N = 194), scheduled frequency of home visits was not reported. Clearly, once-a-week visits were the preferred plan. Parent advisors reported a change in the scheduled frequency for 7.5% of these children, with the change generally in the direction of less frequent home visits.

Because both parents and parent advisors must cancel visits at times because of illness, holidays, and vacations, it was expected that actual frequency of home visits would be slightly less than the scheduled frequency. Beginning with the 1987 data, the actual number of visits recorded was encoded into the data bank. However, not all parent advisors recorded this information at the bottom of the Data Sheet (see Appendix A).

Table 109

Frequencies and Percentages of Children by Scheduled Frequency of Home Visits, 1987-1991

Scheduled Frequency	N	%
Once a Week	4163	83.5
Every Other Week	455	9.1
Twice a Week	177	3.6
Monthly	75	1.5
Irregular Schedule	61	1.2
Bi-Monthly	11	.2
Other	42	.8
Total	4984	100.0

Therefore, actual-frequency-of-home-visit data were available only for the years 1987-1991 and for those children whose parent advisors recorded the data visit by visit. Consequently, we have these data for only 24% of the children (N = 1229). In Table 102, the mean and median for treatment density are provided. On the average, the children actually received 2.6 visits per month (median = 2.5), with a range of from .1 visit per month to 15 visits per month).

Again, these same data can be viewed somewhat differently by inspecting the frequencies and percentages of children stratified by treatment density (Table 110). To stratify, the density values were rounded; Table 110 indicates that 51% of the children received 3 or more home visits per month. Again, the relationships between actual treatment density and five of the demographic variables were of interest. These data follow in this section.

Presence of other handicaps. A low Cramer's V (.08) was obtained for the relationship between treatment density and presence of other handicaps, with only small differences between obtained and expected percentages based on the marginal values (Table 111). The conclusion was that the presence of other handicaps was not associated with treatment density.

Table 110

Frequencies and Percentages of Children by Actual Treatment Density, 1987-1991

Treatment Density	N	%
1 Time per Month	275	22.4
2 Times per Month	326	26.5
3 Times per Month	366	29.8
4 Times per Month	207	16.8
> 4 Times per Month	55	4.5
Total	1229	100.0

Note: M visits per month = 2.6.

Table 111

Frequencies and Percentages of Children by Presence of Another Handicap and Treatment Density, 1987-1991

Density	Other Handicap		No Other Handicap		Total	
	N	%	N	%	N	%
≤ .5x/mo	3	.2	32	2.6	35	2.9
1x/mo	54	4.4	185	15.1	239	19.5
2x/mo	89	7.3	237	19.3	326	26.6
3x/mo	84	6.8	281	22.9	365	29.7
4x/mo	42	3.4	165	13.4	207	16.9
5x/mo or greater	13	1.1	42	3.4	55	4.5
Overall	285	23.2	942	76.8	1227	100.0

Note: Cramer's V = .08. Presence of other handicaps was not associated with treatment density.

Severity of hearing loss. A low Cramer's V (.10) was obtained for the relationship between treatment density and severity of hearing loss (Table 112). Only small differences separated obtained and expected percentages based on the marginal values, indicating that severity of hearing loss was not associated with treatment density.

Age at onset. Again, a low Cramer's V (.08) was obtained for the relationship between treatment density and age at onset, with only small differences separating obtained and expected percentages based on the marginal values (Table 113). The finding was that age at onset was not associated with treatment density.

Language spoken in the home. The relationship between treatment density and language spoken in the home was also low (Cramer's V = .08), with the obtained percentages similar to those expected based on the marginal values (Table 114). Language spoken in the home was not associated with treatment density.

Parental hearing loss. Finally, the relationship between treatment density and presence/absence of a parent with a hearing loss was low (Cramer's V = .07), with the obtained percentages similar to those expected based on the marginal values (Table 115). Presence of parental hearing loss was not associated with treatment density.

Table 112

Frequencies and Percentages of Children by Severity and Treatment Density, 1987-1991

Density	No		Mild		Moderate		Severe		Profound		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
≤ .5x/mo	0	.0	5	.4	5	.4	15	1.3	8	.7	33	2.8
1x/mo	8	.7	20	1.7	27	2.3	106	9.0	68	5.8	229	19.5
2x/mo	17	1.4	30	2.6	69	5.9	120	10.2	81	6.9	317	27.0
3x/mo	16	1.4	19	1.6	70	6.0	155	13.2	90	7.7	350	29.8
4x/mo	21	1.8	22	1.9	40	3.4	82	7.0	28	2.4	193	16.4
5x/mo or greater	4	.3	6	.5	11	.9	21	1.8	11	.9	53	4.5
Overall	66	5.6	102	8.7	222	18.9	499	42.5	286	24.3	1175	100.0

Note: Cramer's V = .10. Severity of hearing loss was not associated with treatment density.

Table 113

Frequencies and Percentages of Children by Treatment Density and Age at Onset, 1987-1991

Treatment Density	At Birth		Birth to 1 Year		1 to 2 Years		2 to 3 Years		3 Years or Greater		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
≤ .5x/mo	14	2.7	1	.2	2	.4	0	.0	0	.0	17	3.2
1x/mo	85	16.1	21	4.0	6	1.1	2	.4	1	.2	115	21.8
2x/mo	108	20.5	25	4.7	10	1.9	6	1.1	1	.2	150	28.5
3x/mo	108	20.5	17	3.2	15	2.8	5	.9	3	.6	148	28.1
4x/mo	53	10.1	8	1.5	6	1.1	2	.4	0	.0	69	13.1
5x/mo or greater	19	3.6	5	.9	4	.8	0	.0	0	.0	28	5.3
Overall	387	73.4	77	14.6	43	8.2	15	2.8	5	.9	527	100.0

Note: Cramer's V = .08. Age at onset was not associated with treatment density.

Table 114

Frequencies and Percentages of Children by Treatment Density and Language Spoken in the Home, 1987-1991

Treatment Density	English		Spanish		ASL		Signed-English		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
≤ .5x/mo	28	2.3	2	.2	2	.2	0	.0	2	.2	34	2.8
1x/mo	205	17.0	8	.7	10	.8	5	.4	5	.4	233	19.3
2x/mo	271	22.4	30	2.5	9	.7	6	.5	2	.2	318	26.3
3x/mo	326	27.0	20	1.7	9	.7	5	.4	2	.2	362	30.0
4x/mo	191	15.8	7	.6	3	.2	3	.2	2	.2	206	17.1
5x/mo or greater	51	4.2	2	.2	1	.1	0	.0	1	.1	55	4.6
Overall	1072	88.7	69	5.7	34	2.8	19	1.6	14	1.2	1208	100.0

Note: Cramer's V = .08. Language spoken in the home was not associated with treatment density.

Table 115

Frequencies and Percentages of Children by Parental Hearing Loss and Treatment Density, 1987-1991

Density	Parent Hearing Impaired		No Hearing-Impaired Parent		Total	
	N	%	N	%	N	%
≤ .5x/mo	6	.5	28	2.3	34	2.8
1x/mo	20	1.6	219	18.0	239	19.6
2x/mo	24	2.0	296	24.3	320	26.3
3x/mo	26	2.1	338	27.8	364	29.9
4x/mo	11	.9	194	15.9	205	16.8
5x/mo or greater	4	.3	51	4.2	55	4.5
Overall	91	7.5	1126	92.5	1217	100.0

Note: Cramer's V = .07. Presence of parental hearing loss was not associated with treatment density.

Communication Methodology

When children are first enrolled in the parent/infant program, the parent advisor checks the communicative placement (diagnostic/prescriptive, aural/oral, total communication, and other) on the Data Sheet and records the date (see Appendix A). Diagnostic/prescriptive refers to those first few months of the child's enrollment in the program when no decision has yet been made as to auditory or total communication methodology. During this time, evaluation data are being collected to aid in making an informed methodology choice. The parent advisors are trained to record when the choice is made and the family begins to use that communication methodology when interacting with their child (the change from diagnostic/prescriptive services to intervention based on an aural/oral or total communication methodology).

The mean and median ages at which the communication methodology choice was made were approximately 29 and 28 months, respectively (Table 116). The age data were missing for 48% of the children (N = 2484). The mean and median time intervals between program start and communication methodology choice were 2.3 and 0 months, respectively (Table 116). Because the means and medians were calculated using data only from those children for whom a communication methodology choice had been made and because for 23% of the children no communication choice had been made or was not reported (see Table 117), the program-start-to-communication-choice time interval data do not reflect those children who were still being evaluated to determine the appropriate methodology. In other words, the means and medians are skewed in the direction of small or zero intervals.

Table 116

Mean, Standard Deviation and Median Ages or Intervals (in Months), 1979-1991

	M	SD	Mdn	N
Age Communication Methodology Begun	28.9	13.6	28	2694
Interval from Program Start to Communication Methodology Choice	2.3	4.6	0	2679

The frequencies and percentages of children for each of the communication methodology levels are provided in Table 117. Overall, for 45% of the children (N = 2187), total communication was selected as the communication methodology, with aural/oral communication selected for approximately 30% (N = 1,470). For 1.6% of the children (N = 76), the communication methodology choice was "other," primarily cued speech. Diagnostic/prescriptive was checked for approximately 23% (N = 1128) of the children. For 6% of the children (N = 317), communication methodology was not reported.

When changes were made in communication after an initial choice had been made, these were recorded by parent advisors and coded in the data bank as a communication change. For 3.8% of the children (N = 198), communication

Table 117

Frequencies and Percentages of Children by Communication Methodology, 1979-1991

Method	N	%
Total Communication	2187	45.0
Aural/oral	1470	30.2
Diagnostic/Prescriptive	1128	23.2
Other	76	1.6
Total	4861	100.0

methodology changed during the time the child was enrolled in the program. Inspection of these changes indicated that for the majority of the children the change was from aural/oral to total communication.

Presence of other handicaps. The relationship between communication methodology and presence of other handicaps was small (Cramer's V = .06). That is, the proportions within the cells were similar to expected proportions based on the marginal values (Table 118), indicating that the presence of other handicaps was not associated with the communication-methodology choice.

Table 118

Frequencies and Percentages of Children with the Presence of Another Handicap by Communication Methodology, 1979-1991

Communication Methodology	Other Handicap		No Other Handicap		Overall	
	N	%	N	%	N	%
Aural/oral	294	8.1	1133	31.1	1427	39.2
Total Communication	491	13.5	1645	45.2	2136	58.7
Other	28	.8	46	1.3	74	2.0
Overall	813	22.4	2824	77.6	3637	100.0

Note: Cramer's V = .06. Presence of other handicaps was not associated with the communication-methodology choice.

Severity of hearing loss. A small Cramer's V (.31) was obtained for the relationship between communication methodology and severity of hearing loss (Table 119). Inspection of the cell values revealed an anticipated finding. That is, the proportions of children with severe and profound hearing losses were greater than expected based on the marginal values for total communication. Further, the proportions of children with no, mild, and moderate losses were greater than expected based on the marginal values for aural/oral. The conclusion was then that severity of hearing loss was associated with communication-methodology choice, but the relationship was small.

Age at onset. The relationship between communication methodology and age at onset was practically nil (Cramer's V = .03), indicating that the proportions within the cells were similar to expected proportions based on the marginal values (Table 120). The conclusion was that age at onset was not associated with communication-methodology choice.

Language spoken in the home. The relationship between communication methodology and language spoken in the home was low (Cramer's V = .12), reflecting a small increase in the percentages of children from homes in which ASL was the primary language who were using total communication (Table 121). This finding was anticipated. There was, then, a slight association between language spoken in the home and communication-methodology choice.

Parental hearing loss. Finally, the relationship between communication methodology and presence/absence of a parent with a hearing loss was low (Cramer's V = .05), with the obtained percentages similar to those expected based on the marginal values (Table 122). The conclusion was that presence of parental hearing loss was not associated with communication-methodology choice.

Table 119

Frequencies and Percentages of Children by Severity of Hearing Loss and Communication Methodology, 1979-1991

Communication Methodology	No		Mild		Moderate		Severe		Profound		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Aural/oral	89	2.6	212	6.3	404	12.0	482	14.3	121	3.6	1308	38.8
Total Communication	12	.4	55	1.6	244	7.2	1013	30.1	676	20.1	2000	59.4
Other	4	.1	9	.3	9	.3	20	.6	18	.5	60	1.8
Overall	105	3.1	276	8.2	657	19.5	1515	45.0	815	24.2	3368	100.0

Note: Cramer's V = .31. Severity of hearing loss was associated with communication-methodology choice, but the degree of the association was small.

Table 120

Frequencies and Percentages of Children by Age at Onset and Communication Methodology, 1979-1991

Communication Methodology	At Birth		Birth to 1 Year		1 to 2 Years		2 to 3 Years		3 Years or Older		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Aural/oral	432	27.1	91	5.7	63	4.0	16	1.0	7	.4	609	38.2
Total Communication	673	42.2	147	9.2	98	6.1	29	1.8	8	.5	955	59.9
Other	23	1.4	3	.2	2	.1	1	.1	1	.1	30	1.9
Overall	1128	70.8	241	15.1	163	10.2	46	2.9	16	1.0	1594	100.0

Note: Cramer's V = .03. Age at onset was not associated with communication-methodology choice.

Table 121

Frequencies and Percentages of Children by Language and Communication Methodology, 1979-1991

Communication Methodology	English		ASL		Spanish		Signed English		Other		Total	
	N	%	N	%	N	%	N	%	N	%	N	%
Aural/oral	1381	37.5	6	.2	51	1.4	2	.1	14	.4	1454	39.4
Total Communication	1858	50.4	106	2.9	119	3.2	48	1.3	29	.8	2160	58.6
Other	68	1.8	2	.1	2	.1	0	.0	1	.0	73	2.0
Overall	3307	89.7	114	3.1	172	4.7	50	1.4	44	1.2	3687	100.0

Note: Cramer's V = .12. Language spoken in the home was slightly associated with communication-methodology choice.

Table 122

Frequencies and Percentages of Children with a Hearing-Impaired Parent by Communication Methodology, 1979-1991

Communication Methodology	HI Parent		No HI Parent		Overall	
	N	%	N	%	N	%
Aural/Oral	112	3.0	1334	36.3	1446	39.3
Total Communication	237	6.5	1918	52.2	2155	58.7
Other	7	.2	66	1.8	73	2.0
Overall	356	9.7	3318	90.3	3674	100.0

Note: Cramer's V = .05. Presence of parental hearing loss was not associated with communication-methodology choice.

Summary of Relationships Between Treatment Variables and Demographic Variables

1. Presence of other handicaps, severity of hearing loss, age at onset, language spoken in the home, and presence of parental hearing loss were not associated with treatment amount.
2. Presence of other handicaps, severity of hearing loss, age at onset, language spoken in the home, and presence of parental hearing loss were not associated with treatment density.
3. Presence of other handicaps, age at onset, and presence of parental hearing loss were not associated with communication-methodology choice. Severity of hearing loss was associated with communication-methodology choice to a small degree; children with severe and profound hearing losses tended to use total communication and children with no, mild, and moderate losses tended to use aural/oral communication. Language spoken in the home was associated with communication-methodology choice to a slight degree, reflecting the tendency to use total communication for children from homes in which ASL was the primary language.

Additional Services

Parent advisors were requested to list and date the initiation of other non-parent/infant program services (other than diagnostic) given to the child and family while the child was in the parent/infant program (see Appendix A). They were requested to list the services by category (educational, speech-and-hearing therapy, mental health, health, social, services for mentally retarded, and other). The frequencies and percentages of children who were reported to have received other services are provided in Table 123. A large percentage of the children (46.3%) received educational services (e.g., preschool) in addition to the home-based programming.

For 51% of the children (N = 2653), no data were recorded in this section of the data sheet. Because it was impossible to determine whether the missing data reflected the absence of additional services or a lack of reporting such services by the parent advisor, no additional analyses were conducted using this variable.

Table 123

Frequencies and Percentages of Children by Other Services Received

Service	N	%
Education	1170	46.3
Other and Combinations	608	24.1
Speech and Hearing	278	11.0
Education and Speech	187	7.4
Health	121	4.8
Mental Health	88	3.5
Social Services	58	2.3
Mental Retardation	15	.6
Total	2525	100.0

Pre-, Post-, and Predicted Language Scores

As stated in the introduction to this report, the SKI*HI program was designed to ameliorate the profound negative effects of a hearing loss on a child's communication and language development. The language input a child receives during the early years of life is crucial to his or her acquisition of communicative/linguistic competence and later academic skills. If the child suffers an early language deprivation, there are profound negative effects on all areas of oral and written language development (semantics, syntax, phonology, pragmatics, writing, and reading) as well as on socialization and cognitive development. As indicated in the literature review for this report, there are few research-based findings regarding the effect of early home-based intervention on communication skills of children with hearing impairments. McConnell (1974) provided a parent-oriented program and audiological management for 94 severe-to-profoundly hearing-impaired preschoolers in a demonstration home. McConnell reported an average gain in language age of 20.8 months at the end of an average instructional interval of 27.8 months, indicating less than one month of gain for every month of instruction. As the data will demonstrate in this section of the report, SKI*HI children, on average, made one month of language gain for every month of intervention.

The parent advisors were trained to administer the Language Development Scale (LDS) (Tonelson & Watkins, 1979) to the children at the time of entry into the program (within the first three months of the child's enrollment in the program) and twice yearly thereafter. The parent advisor recorded the LDS receptive and expressive test scores and the dates whenever the test was given on the SKI*HI Data Sheet (Appendix A). The scores were recorded as receptive and expressive ages, which were the highest ages in months of the highest interval achieved. For example, if the child's highest receptive-age interval was 20-22 months, the receptive age was recorded as 22 months.

The mean pre-, post-, and predicted LDS test scores are provided in Table 124. For both the expressive and receptive scales, the differences between the pre- and posttests were statistically significant. The magnitude of the difference in standard deviation units was large (SMDs = 1.1) by Cohen's (1988) standards. That is, assuming normal distributions, the average score at posttest was 1.1 standard deviations larger than the average score at pretest. Another way of describing this difference is that on average at the posttest, the expressive and receptive language scores were higher than approximately 84% of the expressive and receptive language scores at pretest.

Table 124

Mean, Standard Deviation, and Median Pre-, Post-, and Predicted LDS Scores, 1979-1991

	Overall							
	Expressive				Receptive			
	M	SD	Mdn	N	M	SD	Mdn	N
Pretest Score	14.6	10.8	12	3307	15.9	11.3	12	3311
Posttest Score	26.3*	14.1	24	3307	28.5*	14.4	28	3311
Gain	11.7		12		12.6		16	
SMD	1.1				1.1			
Predicted Posttest Score	21.5**	13.0	18.7	3243	23.3**	13.8	20.5	3246

Note: Average treatment time 12.3 months overall (median = 9 months).
N = Sample Size.
* = Differences between mean pre- and posttest scores were statistically significant, $\underline{p} \leq .05$.
** = Differences between mean post- and predicted-test scores were statistically significant, $\underline{p} \leq .05$.
SMD = Standardized mean difference (i.e., The difference between the means in standard deviation units. For example, the average score at posttest for the SKI*HI expressive LDS scores was approximately one standard deviation greater than the average score at the pretest.)

The average treatment time between the pre- and posttests was 12.3 months (median = 9 months). For the expressive scale, both the mean and median gains were approximately 12 months, indicating that, on average, the children made approximately one month of gain for every month of treatment (median = 1.3 months of gain per month of treatment). For the receptive scale, the mean gain was 12.6 months, again indicating one month of gain for every month of treatment. However, the median receptive language gain was 16 months. With a median gain time of 9 months, 50% of the children made 1.8 months of gain for every month of treatment. For 36% of the children, one or both of the pre- or posttest scores were not reported by the parent advisors.

Additionally, observed expressive and receptive posttest scores were compared to predicted posttest scores. The predicted scores were calculated on a child-by-child basis, using the child's pretest developmental rate (language age divided by chronological age) and multiplying by the posttest chronological age. The predicted means are provided in Table 124 as well. Differences between the mean actual posttests and predicted posttests were statistically significant, indicating that SKI*HI children consistently scored higher at posttest than was predicted based on maturation alone. For 37% of the children, predicted posttest scores could not be computed because parent advisors failed to report either a pre- or posttest score, testing dates, or the children's age.

Proportional Change Indices

The proportional change index (PCI) is a ratio of developmental rate during intervention to developmental rate prior to intervention; it is calculated on a child-by-child basis. Children whose rates of development were slower during intervention than at pretest received PCIs of less than 1.0, and those whose rates of development accelerated during intervention received PCIs greater than 1.0 (Wolery, 1983). The mean and median PCIs for SKI*HI overall are provided in Table 125. The mean expressive and receptive PCIs were both large (2.7 and 2.6, respectively), indicating rates of development during treatment more than twice the developmental rates at pretest. However, when a distribution of scores is skewed, the median more validly reflects average performance. Inspection of the medians reveals that they were large as well (both 1.8), indicating rates of development during treatment that were nearly twice the developmental rates at pretest. For 37% of the children, PCIs could not be computed because parent advisors failed to report essential information for their computation or because the children had not yet been administered a posttest.

Table 125

Mean, Standard Deviation, and Median PCIs, 1979-1991

	Overall							
	Expressive				Receptive			
	M	SD	Mdn	N	M	SD	Mdn	N
PCI	2.7	3.7	1.8	3238	2.6	3.2	1.8	3243

We present in the following subsections analyses of the PCIs by each of the demographic and treatment variables. For each variable, we provide not only means, medians, and standard deviations for both the expressive and receptive scales of the LDS, but also analysis of variance results for determining if there was a statistically significant difference between/among the means and chi-square results for determining if there was a statistically significant difference between/among the medians. Because the PCI values are a function of treatment time (i.e., the PCIs are already adjusted for time in treatment), analysis of covariance using treatment time as a covariate was deemed inappropriate and was not used for these analyses.

Gender

For both the expressive and receptive LDS scales, no statistically significant differences between the mean or median PCIs for males and females were obtained (Table 126). For both scales, males and females obtained median PCIs of 1.8. The mean PCIs for males and females differed only slightly.

Table 126

Means, Standard Deviations, Medians, and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Gender

Statistic	Male	Female	Difference	F	χ^2
		Expressive PCIs			
M	2.7	2.7	.0	.13	
SD	3.8	3.7			
Mdn	1.8	1.8	.0		.0
N	1741	1453			
		Receptive PCIs			
M	2.5	2.7	.2	.99	
SD	3.3	3.2			
Mdn	1.8	1.8	.0		.1
N	1740	1460			

Note: No statistically significant difference between means or medians, $p \leq .05$.

Ethnicity

For both scales, the differences among the median PCIs for the ethnic group were not statistically significant (Table 127). Although a statistically significant difference among the mean PCIs was obtained for the expressive scale, the Eta^2 was essentially zero (<.01), indicating no relationship between ethnicity and expressive language PCIs. Post-hoc analyses indicated that Asian Americans obtained a statistically significantly higher mean score than the other ethnic groups. No statistically significant difference among the receptive mean PCIs was obtained.

Table 127

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Ethnicity

	Caucasian	African American	Asian American	Spanish American	Native American	Others	F	χ^2
			Expressive PCIs					
M	2.7	2.9	5.4	2.6	2.6	2.7	3.2*	
SD	3.6	3.7	10.9	3.5	2.8	3.3		
Mdn	1.8	1.8	2.2	1.6	1.9	1.9		3.7
N	2351	462	29	285	46	35		
			Mean Differences					
Caucasian		.2	2.7	.1	.1	.0		
African American			2.5	.3	.3	.2		
Asian American				2.8	2.8	2.7		
Spanish American					.0	.1		
Native American						.1		
			Median Differences					
Caucasian		.0	.4	.2	.1	.1		
African American			.4	.2	.1	.1		
Asian American				.6	.3	.3		
Spanish American					.3	.3		
Native American						.0		
			Receptive PCIs					
M	2.5	2.9	3.7	2.6	2.4	2.4	1.6	
SD	3.2	3.7	3.6	3.2	1.8	2.0		
Mdn	1.8	1.7	2.4	1.5	2.1	2.2		5.2
N	2356	462	29	286	45	35		
			Mean Differences					
Caucasian		.4	1.2	.1	.1	.1		
African American			.8	.3	.5	.5		
Asian American				1.1	1.3	1.3		
Spanish American					.2	.2		
Native American						.0		
			Median Differences					
Caucasian		.1	.6	.3	.3	.4		
African American			.7	.2	.4	.5		
Asian American				.9	.3	.2		
Spanish American					.6	.7		
Native American						.1		

Note: * = Statistically significant difference among the means, $p \leq .05$.

Other Handicaps

For both scales, the difference between the median PCIs for children with and without additional handicaps was statistically significant (Table 128). Children without an additional handicap obtained the highest median PCIs (1.8 and 1.9).

For both scales, a statistically significant difference was obtained between the mean PCIs as well; however, the Eta^2 values were less than .01. The mean PCIs for children without additional handicaps were 2.8 and 2.7, with the mean PCIs for children with additional handicap 2.4 and 2.3.

Table 128

Means, Standard Deviations, Medians, and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Presence of Other Handicaps

Statistic	Other Handicap Present	Other Handicap Not Present	Difference	F	χ^2
		Expressive PCIs			
M	2.4	2.8	.4	5.3*	
SD	3.6	3.8			
Mdn	1.5	1.8	.3		13.3*
N	732	2436			
		Receptive PCIs			
M	2.3	2.7	.4	6.8*	
SD	3.1	3.3			
Mdn	1.5	1.9	.4		22.5*
N	738	2435			

Note: *Statistically sig. difference between means and medians, $p \leq =.05$.

Type of Hearing Loss

For the expressive scale, the difference among the median PCIs for the types of hearing loss was not statistically significant, with the medians ranging from 1.6 to 1.8 (Table 129). For the receptive scale, the difference among the medians was statistically significant. The medians ranged from 1.5 to 1.8. Inspection of the cells indicated that there were more children with sensorineural hearing losses who obtained PCIs greater than the median than expected.

For both language scales, the differences among the mean PCIs for the types of hearing loss were not statistically significant, with Eta^2 values less than .01. For the expressive scale, the mean PCIs ranged from 2.5 to 2.7; for the receptive scale they ranged from 2.3 to 2.6.

Table 129

Means, Standard Deviations, Medians, and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Type of Hearing Loss

	Conductive	Sensorineural	Mixed	F	χ^2
		Expressive PCIs			
M	2.7	2.7	2.5	.3	
SD	3.9	3.8	3.3		
Mdn	1.6	1.8	1.7		1.5
N	188	2655	242		
		Mean Differences			
Conductive		.0	.2		
Sensorineural			.2		
		Median Differences			
Conductive		.2	.1		
Sensorineural			.1		
		Receptive PCIs			
M	2.2	2.6	2.3	2.6	
SD	2.4	3.3	3.0		
Mdn	1.5	1.8	1.6		6.1*
N	188	2657	243		
		Mean Differences			
Conductive		.4	.1		
Sensorineural			.3		
		Median Differences			
Conductive		.3	.1		
Sensorineural			.2		

Note: * = Statistically significant difference among means or medians, $p \leq .05$.

Severity of Hearing Loss

For the expressive scale, the difference among the median PCIs for the hearing-loss severity levels was not statistically significant, with the medians ranging from 1.6 to 2.1 (Table 130). For the receptive scale, the difference among the medians was statistically significant. The medians ranged from 1.6 to 1.9. Inspection of the cells indicated that more children than expected with severe hearing losses obtained PCIs greater than the median and more children than expected with profound hearing losses obtained PCIs less than the median, based on the marginal values.

For the expressive scale, the difference among the mean PCIs for the hearing-loss severity levels was not statistically significant. The means ranged from 2.5 to 3.1. For the receptive scale, the difference among the means was statistically significant; however, the Eta^2 was essentially zero. The means ranged from 2.3, for children with no loss, to 2.8, for children with severe losses.

Table 130

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Level of Unaided Hearing Loss, 1979-1991

	Normal	Mild	Moderate	Severe	Profound	*F*	χ^2
			Expressive PCIs				
M	3.1	2.6	2.5	2.8	2.7	1.2	
SD	6.2	3.4	2.9	3.8	3.6		
Mdn	2.1	1.8	1.6	1.8	1.7		4.2
N	101	244	597	1346	678		
			Mean Differences				
Normal		.5	.6	.3	.4		
Mild			.1	.2	.1		
Moderate				.3	.2		
Severe					.1		
			Median Differences				
Normal		.3	.5	.3	.4		
Mild			.2	.0	.1		
Moderate				.2	.1		
Severe					.1		
			Receptive PCIs				
M	2.3	2.4	2.4	2.8	2.4	3.1*	
SD	2.1	3.2	2.4	3.9	2.6		
Mdn	1.8	1.7	1.7	1.9	1.6		10.6*
N	101	246	599	1346	680		
			Mean Differences				
Normal		.1	.1	.5	.1		
Mild			.0	.4	.0		
Moderate				.4	.0		
Severe					.4		
			Median Differences				
Normal		.1	.1	.1	.2		
Mild			.0	.2	.1		
Moderate				.2	.1		
Severe					.3		

Note: * = Statistically significant difference among the means or medians.

Cause of Hearing Loss

For both scales, the differences among the medians were statistically significant for the causes of hearing loss (Table 131). For both scales, inspection of the cell frequencies revealed more children than expected with PCIs greater than the median whose cause of loss was fever or infection and more children than expected with PCIs less than the median whose cause of loss was a syndrome. The medians ranged from 1.4, for children whose cause of loss was a birth defect or a syndrome, to 2.5, for children whose cause of loss was fever or infection. For the receptive scale, the medians ranged from 1.2, for children whose cause of loss was a syndrome, to 2.9, for children whose cause of loss was fever of infection.

For both scales, the differences among the mean PCIs for the causes of hearing loss were statistically significant; however, the Eta^2 values were low (.02 for both scales). For the expressive scale, post-hoc analyses indicated that the mean PCI for children whose cause of loss was fever or infection was statistically significantly higher than the mean PCIs for children whose cause of loss was a syndrome, heredity, rubella, defects at birth, meningitis, or middle-ear problems. The mean PCIs ranged from 2.0 to 4.5. For the receptive language scale, post-hoc analyses indicated that the mean PCI for children whose cause of loss was fever or infection was statistically significantly higher than the mean PCIs for children whose cause of loss was a syndrome, heredity, rubella, defects at birth, meningitis, or middle-ear problems. The mean PCIs ranged from 1.8 to 3.8.

Table 131

Means, Standard Deviations, Medians, and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Cause of Hearing Loss, 1979-1991

	Unknown	Heredity	Rubella CMV	Meningitis	Birth Defect	Fever in Child	Rh or Kernicterus	Drugs During Pregnancy	Other Conditions During Pregnancy	Middle Ear	Drugs to Child	Birth Trauma	Child Syndrome	Other	Overall	F	χ^2
								Expressive PCIs									
M	2.9	2.3	2.3	2.6	2.3	4.5	2.0	2.9	2.7	2.8	2.6	2.7	2.2	2.7		2.4*	
SD	3.7	2.9	2.2	4.2	3.6	7.6	1.4	2.7	3.0	3.1	3.4	4.5	2.7	4.2			
Mdn	1.9	1.5	1.8	1.7	1.4	2.5	2.0	2.3	1.7	2.0	1.8	1.6	1.4	1.9			27.1*
N	1587	341	108	401	151	82	20	19	110	136	31	87	91	74	3238		
								Receptive PCIs									
M	2.8	2.2	2.2	2.5	2.2	3.8	2.5	2.2	2.6	2.5	2.9	2.7	1.8	2.1		2.6*	
SD	3.6	2.5	2.0	3.3	2.6	4.3	1.6	1.5	2.6	2.8	2.5	4.2	1.9	1.7			
Mdn	1.9	1.5	1.7	1.6	1.5	2.9	2.3	1.9	1.9	1.8	2.2	1.6	1.2	1.7			26.5*
N	1588	342	109	402	151	81	20	19	109	136	31	87	94	74	3243		

Note: *= Statistically significant difference among means or medians, $p \leq .05$.
Analysis of variance and X^2 conducted excluding unknown and other categories.

Age at Onset

For the expressive scale, no statistically significant difference among the median PCIs for the age-at-onset levels was obtained (Table 132). The medians ranged from 1.6 to 2.9. For the receptive scale, a statistically significant difference among the median PCIs was obtained. Inspection of the cell frequencies revealed more children than expected with PCIs greater than the median whose age at onset was 1-to-2 years or greater and more children than expected with PCIs less than the median whose age at onset was at birth. The medians ranged from 1.6 to 3.2.

For both scales, a statistically significant difference among the mean PCIs for the age-at-onset levels was obtained; however, the Eta^2 values were low (.01 for both scales). For the expressive scale, the means ranged from 2.4, for children whose onset was at birth, to 7.6, for children whose onset was at three years or older. Post-hoc analyses indicated that the mean PCI for children whose onset was at three years or older was statistically significantly higher than that for all other groups of children. For the receptive scale, post-hoc analyses revealed that no two means differed significantly. The means ranged from 2.3, for children whose age at onset was at birth, to 3.4, for children whose age at onset was two to three years.

Table 132 reveals a tendency for the medians to increase in magnitude as age at onset increases. This finding is not surprising. If a hearing loss is identified at birth and intervention is begun early, the developmental rate prior to intervention is more likely to approximate one (i.e., if developmental age equals chronological age, pretest developmental rate = 1) than if the onset is later and the child is not identified immediately (e.g., if developmental age equals 18 months and chronological age equals 36 months, pretest developmental rate = .5). Thus, the denominator in the equation for calculating PCIs is larger if pretest developmental rate is equal to 1, resulting in smaller PCIs.

Table 132

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Age at Onset, 1979-1991

	At Birth	Birth to 1 Year	1 to 2 Years	2 to 3 Years	≥ 3 Years	*F*	χ^2
Expressive PCIs							
M	2.4	2.7	2.9	2.4	7.6	4.2*	
SD	3.4	3.6	4.9	2.7	15.5		
Mdn	1.6	1.7	1.5	2.0	2.9		1.8
N	996	210	143	36	8		
Mean Differences							
At Birth		.3	.5	.0	5.2		
Birth to 1 Year			.2	.3	4.9		
1 to 2 Years				.5	4.7		
2 to 3 years					5.2		
Median Differences							
At Birth		.1	.1	.4	1.3		
Birth to 1 Year			.2	.3	1.2		
1 to 2 Years				.5	1.4		
2 to 3 Years					.9		
Receptive PCIs							
M	2.3	2.6	2.8	3.4	2.8	2.5*	
SD	2.6	3.6	3.6	4.0	1.8		
Mdn	1.6	1.6	1.8	2.2	3.2		10.1*
N	1000	211	144	36	8		
Mean Differences							
At Birth		.3	.5	1.1	.5		
Birth to 1 Year			.2	.8	.2		
1 to 2 Years				.6	.0		
2 to 3 Years					.6		
Median Differences							
At Birth		.0	.2	.6	1.6		
Birth to 1 Year			.2	.6	1.6		
1 to 2 Years				.4	1.4		
2 to 3 Years					1.0		

Note: * = Statistically significant difference among means/medians, $p \leq .05$.

Language Spoken in the Home

For the expressive language scale, the difference among the median PCIs for the levels of language spoken was statistically significant (Table 133). Inspection of cell frequencies revealed more children than expected with PCIs less than the median whose home language was ASL and more children than expected with PCIs greater than the median whose home language was signed English. The medians ranged from 1.3 to 2.2. For the receptive scale, the difference among the medians was not statistically significant. The medians ranged from 1.1 to 1.8.

For the expressive language scale, a statistically significant difference among the mean PCIs was obtained for the levels of language spoken in the home; however, the Eta^2 was essentially zero (<.01). The means ranged from 2.0 for children whose home language was ASL, to 4.5, for children whose home language was another international language. Post-hoc analyses indicated that the mean PCI for children whose home language was "other" was statistically significantly higher than the mean PCIs for children whose home language was ASL, Spanish, or English. For the receptive language scale, no statistically significant difference among the mean PCIs was obtained, with Eta^2 less than .01. The means ranged from 1.9, for children whose home language was ASL, to 3.0, for children whose home language was "other."

It is likely that the small mean and median PCIs obtained for children whose home language was ASL reflect the fact that such children were identified at an earlier age than children from homes in which other languages were used (see Table 55, Chapter 6) and children from homes in which neither parent was hearing impaired (see Table 56, Chapter 6). As with the discussion for age at onset, smaller PCIs will be obtained whenever pretest developmental rate approximates one (i.e., when developmental age approximates chronological age). And again, for all groups, mean and median PCIs were greater than one.

Table 133

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Language Spoken in the Home, 1979-1991

	English	ASL	Spanish	Signed English	Other	F	χ^2
Expressive PCIs							
M	2.7	2.0	2.6	3.4	4.5	3.5*	
SD	3.6	2.4	3.0	5.4	9.5		
Mdn	1.8	1.3	1.6	2.2	1.9		22.3*
N	2893	84	137	41	41		
Mean Differences							
English		.7	.1	.7	1.8		
ASL			.6	1.4	2.5		
Spanish				.8	1.9		
Sgn.Eng.					1.1		
Median Differences							
English		.5	.2	.4	.1		
ASL			.3	.9	.6		
Spanish				.6	.3		
Sgn.Eng.					.3		
Receptive PCIs							
M	2.6	1.9	2.6	2.5	3.0	1.3	
SD	3.3	1.8	2.9	4.8	3.3		
Mdn	1.8	1.1	1.6	1.6	1.3		10.0
N	2899	84	137	41	41		
Mean Differences							
English		.7	.0	.1	.4		
ASL			.7	.6	1.1		
Spanish				.1	.4		
Sgn.Eng.					.5		
Median Differences							
English		.7	.2	.2	.5		
ASL			.5	.5	.2		
Spanish				.0	.3		
Sgn.Eng.					.3		

Note: * = Statistically significant difference among means/medians, $p \leq .05$.

Parental Hearing Loss

For the expressive language scale, no statistically significant difference was obtained between the median PCIs for children with and without a parent with a hearing loss (Table 134). For the receptive scale, the difference between the medians was statistically significant. Children without a hearing-impaired parent obtained the highest median (2.8).

For the expressive scale, no statistically significant difference was obtained between the mean PCIs, and the Eta_2 was less than .01. The means were 2.3 and 2.8. For the receptive scale, a statistically significant difference between the means was obtained. However, Eta^2 was again practically zero (<.01). Children without a hearing-impaired parent obtained the highest mean (2.6).

Table 134

Means, Standard Deviations, Medians, and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Presence of Hearing Impaired Parent, 1979-1991

Statistic	At Least One Parent Hearing Impaired	Neither Parent Hearing Impaired	Difference	Overall	F	χ^2
		Expressive PCIs				
M	2.3	2.8	.5	2.7	3.2	
SD	2.8	3.8		3.7		
Mdn	1.6	1.8	.2	1.8		3.8
N	274	2915		3189		
		Receptive PCIs				
M	2.1	2.6	.5	2.6	6.0*	
SD	2.4	3.3		3.2		
Mdn	1.5	1.8	.3	1.8		4.2*
N	274	2920		3194		

Note: * Statistically significant difference between the means/medians, $p \geq .05$.

Treatment Amount

For both scales, statistically significant differences among the median PCIs for the treatment-amount levels were obtained (Table 135). For the expressive scale, the medians ranged from 1.4, for treatment amounts greater than 24 months, to 2.2, for treatment amounts of 0-to-6 months. For the receptive scale, the medians ranged from 1.3, for treatment amounts greater than 24 months, to 2.3, for treatment amounts of 0-to-6 months.

For both scales, the differences among the mean PCIs for the treatment-amount levels were statistically significant. However Eta^2 was low for both analyses (.02), indicating little relationship between treatment amount and the ratios of developmental rate during treatment to developmental rate prior to treatment.

For both scales, post-hoc analyses revealed that children whose treatment amounts were less than six months obtained higher mean PCIs than children whose treatment amounts were six months or greater. In fact, mean PCIs tended to decrease as treatment amount increased. Inspection of the cell frequencies above and below the medians from the chi-square tests of the medians revealed the same pattern. Exploratory analyses were conducted to assist in understanding the reasons for this pattern, because it would seem to indicate that the effectiveness of the program diminished with increases in treatment time.

Again, the formula for computing PCIs is a ratio of intervention rate (i.e., gain from pre- to posttest divided by gain time) to pretest developmental rate (i.e., language age divided by chronological age). Exploratory analyses revealed that the pretest developmental rates (the denominators of the equations) were similar across the treatment-amount levels, indicating that the pattern of decreasing PCIs was not associated with pretest developmental rates.

The alternative was then explored--that is, that the pattern of decreasing mean and median PCIs was associated with the numerator of the equation--the intervention rates. The intervention rates did, in fact,

Table 135

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Treatment Amount (in Months), 1979-1991

	0 to 6	6 to 12	12 to 18	18 to 24	> 24	*F*	χ^2
			Expressive PCIs				
M	3.8	2.9	2.7	2.4	1.8	20.0*	
SD	6.0	3.6	3.5	2.9	1.7		
Mdn	2.2	2.0	1.8	1.6	1.4		67.7*
N	463	985	716	503	544		
			Mean Differences				
0 to 6		.9	1.1	1.4	2.0		
6 to 12			.2	.5	1.1		
12 to 18				.3	.9		
18 to 24					.4		
			Median Differences				
0 to 6		.2	.4	.6	.8		
6 to 12			.2	.4	.6		
12 to 18				.2	.4		
18 to 24					.2		
			Receptive PCIs				
M	3.6	2.8	2.5	2.3	1.7	25.1*	
SD	5.6	3.1	2.5	2.3	1.5		
Mdn	2.3	2.1	1.8	1.6	1.3		105.6*
N	464	983	719	504	546		
			Mean Differences				
0 to 6		.8	1.1	1.3	1.9		
6 to 12			.3	.5	1.1		
12 to 18				.2	.8		
18 to 24					.6		
			Median Differences				
0 to 6		.2	.5	.7	1.0		
6 to 12			.3	.5	.8		
12 to 18				.2	.5		
18 to 24					.3		

Note: * = Statistically significant difference among means/medians, $p \leq .05$.

decrease with increases in treatment amounts, indicating that large gains in language scores were observed for the children who had received smaller treatment amounts, with smaller gains observed for the children who have received greater treatment amounts at the time of this analysis.

Because the children were fitted with appropriate amplification, provided with both auditory and communication-language programming, and provided with a communication system (aural/oral or total communication), such large gains in the first few months of the program are anticipated. For example, if a child with a chronological age of 24 months and a language age of 4 months entered the program, immediate language gains were achieved in the first few months of intervention. Although the large gains tended to decrease as treatment amount increased, it should be emphasized that the mean and median PCIs still remained greater than one, indicating that the intervention developmental rate was still greater than the pretest developmental rate even for children who received 24 months or more of treatment.

Treatment Density

For both scales, the differences among the median PCIs for the treatment-density levels were statistically significant (Table 136). Inspection of the chi-square tables revealed a higher percentage than expected of PCIs larger than the median for children who received home visits four times per month. For the expressive scale, the medians ranged from 1.2, for children who received home visits .5 times per month or less, to 2.0, for children who received home visits 4 times per month. For the receptive scale, the medians ranged from 1.1, for children who received home visits .5 times per month or less, to 2.1, for children who received home visits 4 times per month.

For both scales, the difference among the mean PCIs for the treatment-density levels were not statistically significant, with the Eta^2 values essentially zero. The expressive means ranged from 2.1, for children who received home visits one time per month, to 2.6, for children with home visits three times per month. The receptive means ranged from 2.1 for children who received home visits one time per month, to 3.0, for children with visits greater than five times per month.

Table 136

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Treatment Density, 1987-1991

	≤ .5x/mo	1x/mo	2x/mo	3x/mo	4x/mo	≥5x/mo	F	χ^2
			Expressive PCIs					
M	2.2	2.1	2.4	2.6	2.5	2.5	.9	
SD	2.8	2.4	2.9	3.4	2.5	2.8		
Mdn	1.2	1.5	1.6	1.8	2.0	1.4		13.0*
N	35	240	325	365	207	54		
			Mean Differences					
≤ .5x/mo		.1	.2	.4	.3	.3		
1x/mo			.3	.5	.4	.4		
2x/mo				.2	.1	.1		
3x/mo					.1	.1		
4x/mo						.0		
			Median Differences					
≤ .5x/mo		.3	.4	.6	.8	.2		
1x/mo			.1	.3	.5	.1		
2x/mo				.2	.4	.2		
3x/mo					.2	.4		
4x/mo						.6		
			Receptive PCIs					
M	2.2	2.1	2.1	2.6	2.8	3.0	2.0	
SD	3.4	2.1	2.2	4.5	2.6	5.5		
Mdn	1.1	1.5	1.6	1.8	2.1	1.3		31.7*
N	35	239	326	366	206	55		
			Mean Differences					
≤ .5x/mo		.1	.1	.4	.6	.8		
1x/mo			.0	.5	.7	.9		
2x/mo				.5	.7	.9		
3x/mo					.2	.4		
4x/mo						.2		
			Median Differences					
≤ .5x/mo		.4	.5	.7	1.0	.2		
1x/mo			.1	.3	.6	.2		
2x/mo				.2	.5	.3		
3x/mo					.3	.5		
4x/mo						.8		

Note: * = Statistically significant difference among the medians, $p \leq .05$.

Communication Methodology

For both language scales, the differences among the median PCIs for the communication methods were statistically significant (Table 137). Inspection of the chi-square tables revealed a higher than expected percentage of PCIs that were less than the median for children using aural/oral communication. For the expressive scales, the medians ranged from 1.6, for children using aural/oral communication, to 2.1, for children using "other" communication (e.g., cued speech). For the receptive scale, the medians ranged from 1.7, for children using aural/oral communication, to 2.6, for children using other communication.

For both scales, the differences among the mean PCIs for the communication methods were statistically significant. However, the Eta^2 values were essentially zero. The expressive means ranged from 2.5, for children who used aural/oral communication, to 3.6, for children using other communication. The receptive means ranged from 2.2, for children using aura/oral communication, to 2.9, for children using total communication. Post-hoc analyses revealed that the mean PCIs for children using total communication were statistically significantly larger than the mean PCIs for children using aural/oral communication, for both the expressive and receptive scales.

These findings are best understood by recalling that we reported previously in this chapter that greater percentages of children with severe and profound hearing losses used total communication (Table 119). Exploratory analyses revealed that children with severe and profound hearing losses tended to have small pretest developmental rates. When using the PCI formula (the ratio of intervention developmental rate to pretest developmental rate), then, we were dividing the intervention developmental rate by a small value, resulting in large PCIs for children using total communication.

Table 137

Means, Standard Deviations, Medians and ANOVA and Chi-Square Results for Expressive and Receptive PCIs by Communication Methodology, 1979-1991

	Aural/ Oral	Total Comm	Other	*F*	χ^2
		Expressive PCIs			
M	2.5	2.9	3.6	3.8*	
SD	3.7	3.6	6.0		
Mdn	1.6	1.9	2.1		8.2*
N	772	1180	23		
		Mean Differences			
Aural/oral		.4	1.1		
Total Communication			.7		
		Median Differences			
Aural/oral		.3	.5		
Total Communication			.2		
		Receptive PCIs			
M	2.2	2.9	2.8	9.3*	
SD	2.2	3.9	2.3		
Mdn	1.7	1.9	2.6		6.2*
N	775	1182	23		
		Mean Differences			
Aural/oral		.7	.6		
Total Communication			.1		
		Median Differences			
Aural/oral		.2	.9		
Total Communication			.7		

Note: * = Statistically significant difference among the means/medians.

Summary for Pre-, Post-, and Predicted Language Gains and PCIs

At this point we have presented two types of program-effectiveness data: pre-, post-, and predicted language gains and *PCI*s. A summary of those findings is provided here.

1. Overall, pre-to-post developmental gains in receptive and expressive language were statistically significant and educationally important, with large standardized mean differences. On average, SKI*HI children made one month of language gain for every month of intervention (medians = 1.3 months of expressive language gain per month of treatment and 1.8 months of receptive language gain per month of treatment).
2. Overall, the difference between actual posttest means and predicted posttest means were statistically significant, with the actual posttest means higher than what was predicted based on maturation alone.
3. Overall, the median PCIs were large, with a rate of development during intervention that was nearly twice the rate of development prior to intervention.
4. Median PCIs were largest for children without an additional handicap.
5. For the receptive language scale, median PCIs were largest for children with a sensorineural hearing loss and for children with severe hearing losses.
6. For both scales, median PCIs were largest for children whose cause of hearing loss was fever or infection and for children whose age at onset was 2 to 3 years.
7. For both scales, median PCIs were smallest for children whose home language was ASL, reflecting the fact that such children were identified at an earlier age than children from homes in which other languages were used and children from homes in which neither parent was hearing impaired (see Chapter 6).
8. Median PCIs were largest for children who received treatment amounts of 12 months or less and for children who received treatment four times per month.
9. Median PCIs were largest for children using total communication.

Value-Added Analysis

Value-added analysis (Bryk & Weisberg, 1976; Hebbeler, 1985; Markowitz et al., 1991) was used to estimate the growth associated with participation in the program, over-and-above the growth associated with maturation. Using the total distribution of the children's scores at the pretest as well as the total distribution of the children's ages at the pretest, pretest scores were regressed on pretest chronological ages. The resulting coefficient estimated the language growth rate prior to intervention. Because hearing-loss severity was hypothesized to be related to developmental growth in our population, we incorporated unaided hearing thresholds into the equation as well. The univariate correlation coefficients follow in Table 138:

Table 138

Univariate Correlation Coefficients for Value-Added Analysis

	Pretest LDS Expressive	Pretest LDS Receptive	Hearing Threshold
Pretest CA	.66	.67	-.14
Pretest LDS Expressive		.95	-.24
Pretest LDS Receptive			-.24

The regression equations used to estimate each child's growth associated with maturation alone follow: $Y' = .6352 + (-.1448X)$ for the expressive scale and $Y' = .6494 + (-.149X)$ for the receptive scale. In the equations, Y' equaled the predicted score and X equaled hearing threshold level in standardized dB values (with a mean = 0 and a standard deviation = 1). For the expressive and receptive scales, the multiple $\underline{R}$ = .67 and .69, respectively.

Using the equations, for each child the resulting values were multiplied by the amount of time between the pretest and the posttest scores to estimate the amount of growth due to maturation alone for each of the language scales. To determine the child's total growth, the pretest score was subtracted from the posttest score for each scale. Finally the growth associated with maturation was subtracted from the total growth to estimate the growth associated with program participation (i.e., the value added) for each scale.

In Table 139 we report the mean value added (in months) as well as a mean value added per month (i.e., value added divided by time between the pretest and posttest). For SKI*HI overall for the expressive and receptive scales, the mean gain associated with maturation was 7.7 and 7.9 months, respectively. The mean value added, over and above maturation, was 4.2 and 4.9 months, respectively. The mean value added per month was .5.

For the hearing-loss severity levels, inspection of Table 139 reveals that with increases in hearing-loss severity, the mean value added increased. That is, for children with no loss or mild losses, the value-added means ranged from approximately two months to three months; for children with severe and profound hearing losses, the value-added means ranged from 4.3 months to 6.4 months. The value-added-per-month means tended to increase with increases in hearing-loss-severity levels as well (from .4 to .6). Finally, the mean gain times increased with increases in hearing-loss severity, resulting in mean values added per month that varied little across the hearing-loss severity levels (.4 to .6).

For communication methodology, inspection of Table 139 reveals only slight differences in the value-added means, with the value-added-per-month means being nearly identical. The mean gain times differed slightly, with children using total communication tending to remain in intervention longer than children using aural/oral communication. The mean values added per month did not differ for the two communication methodologies.

Predicting Posttest Scores

A multiple-regression analysis was conducted to determine the optimal linear combination of treatment variables for predicting language development rates during intervention. We computed intervention efficiency indexes (IEI) for both the expressive and receptive scales of the LDS by calculating the gain from pre- to posttest and dividing by the time from pre- to posttest. We present first the correlation coefficients among the treatment variables

Table 139

Value-Added Analysis, Mean Maturation Gain, Mean Value-Added Gain, Mean Value-Added Gain per Month, and Gain Time, Overall and by Hearing-Loss Severity and Communication Methodology (in Months), 1979-1991

	M Gain Maturation	M Gain Value Added	M Value Added Points/Mo.	M Gain Time
OVERALL N = 2973				
Expressive	7.7	4.2	.5	11.9
Receptive	7.9	4.9	.5	
Hearing-Loss Severity				
No Loss (n = 101)				
Expressive	8.4	1.9	.4	8.7
Receptive	8.6	1.9	.4	
Mild (n = 246)				
Expressive	8.7	2.8	.5	10.2
Receptive	8.9	3.0	.5	
Moderate (n = 597)				
Expressive	8.8	3.3	.4	11.7
Receptive	9.0	3.9	.5	
Severe (n = 1350)				
Expressive	7.8	4.3	.5	12.9
Receptive	8.0	5.2	.6	
Profound (n = 680)				
Expressive	6.2	5.6	.5	13.6
Receptive	6.3	6.4	.6	
Communication Methodology				
Aural/oral (n = 896)				
Expressive	7.9	4.3	.5	11.3
Receptive	8.1	4.7	.6	
Total Communication (n = 1457)				
Expressive	7.9	4.7	.5	13.5
Receptive	8.0	5.5	.5	

Table 140

Correlation Coefficients for Predicting Developmental Rates During Intervention

	Treatment Amount	Treatment Density	Communication Methodology	Expressive IEI	Receptive IEI
Program-Start Age	-.33*	.08*	-.09*	.28*	.26*
Treatment Amount		-.41*	.10*	-.26*	-.26*
Treatment Density			-.08*	.15*	.20*
Communication Method				-.13*	-.11*
Expressive IEI					.82*

Note. * = statistically significant, $p \leq .05$.

(program-start age, treatment amount, treatment density, and communication methodology) and the expressive and receptive IEIs (Table 140).

The correlation coefficients were zero to small, indicating little relationship between any pair of variables. Exploratory analyses revealed that two of the predictor variables (communication methodology and treatment density) should be removed from the multiple-regression analysis because they had little variability in common with the criterion variables--expressive and receptive language intervention developmental rates. Also, because treatment density was available only for children who had been in the program between the years 1987-88 through 1990-91, this variable was not appropriate as a predictor for the total population of scores.

The multiple Rs for predicting expressive and receptive IEIs were .33 and .32, respectively (Table 141). With R^2 equal to .11 and .10, respectively, these data indicate that only 10% to 11% of the variability in intervention developmental rates is explained by the linear combination of program-start age and treatment amount.

Table 141

Multiple-Regression Analyses for Predicting Developmental Rate During Intervention

	Beta Coefficients				
	Program-Start Age	Treatment Amount	R	R^2	N
Expressive IEI	.216	-.185	.33*	.11	2881
Receptive IEI	.190	-.202	.32*	.10	2881

Note: * = Statistically significant, $p \leq .05$.

Child Outcomes

The child-outcome data were coded into the National Data Bank only for the 1987 through 1991 program years. The data were obtained from the lower portion of the SKI*HI Data Sheets (Appendix A). Parent advisors recorded session-by-session observations under the section entitled Child Data. For the 1987 through 1991 program years, data for a total of 2,178 children were submitted. However, not all parent advisors completed the lower portion of the data sheet, or they recorded data only monthly rather than session by session. Furthermore, not all children wore a hearing aid, particularly children with no or mild conductive hearing losses. Consequently, the sample sizes for the child-outcome data are smaller than those obtained for the demographic data. We will report here the child outcomes for level of hearing-aid use, threshold improvement, auditory development, communication-language development, and vocabulary development.

Level of Hearing-Aid Use

The parent advisor taught the parents what the hearing aid is and how to manage it. The parent advisor also provided lessons on related topics, such as the nature of sound, the importance of hearing for language development, hearing assessment, speech perception, and causes and types of hearing losses. The goals of the home-hearing-aid program included: (a) that the child will be properly fit with hearing aids and earmolds that allow maximum use of residual hearing acuity; (b) that the child will accept the hearing aid within the first few weeks of the fitting; and (c) that the parents will demonstrate understanding of the important skills and concepts in the hearing-aid lessons, which include the importance of appropriate, consistent amplification as well as the daily listening check, trouble shooting for feedback, and caring for the hearing aid.

One measure of program effectiveness is whether the child wore the hearing aid full-time. Parent advisors were instructed to write down the number of the appropriate time interval (1 = < 1/4 time, 2 = 1/4 to 1/2 time, 3 = 1/2 to 3/4 time, 4 = over 3/4 time, and 5 = all of the time) underneath the session date. If the child did not achieve a new time interval by the time of the session, then the space by Time Hearing Aid Worn was left blank for that session's date. When the child wore the aid for all waking hours or the hearing-aid time recommended by the audiologist, reporting was discontinued and was indicated by a slash on the data sheet for that session.

In Table 142 we present the frequencies and percentages of children for each level of hearing-aid use and the mean and median time in months that it took to attain the highest level of hearing-aid use. Seventy-three percent of the children achieved 3/4-time to full-time hearing-aid use. The remainder of the children were in the process of achieving full-time hearing-aid use. The median amount of time that it took to achieve full-time hearing-aid use was one month.

The percentages of children for each level of hearing-aid use are also provided in Table 142 by severity of hearing loss, type of hearing loss, and communication methodology. Clearly, the largest percentages of children who were wearing their hearing aid full time were children with severe and profound sensorineural hearing losses. The low Cramer's V (.16) for the relationship between communication methodology and level of hearing-aid use reflects the slightly larger-than-expected percentage, based on the marginal values, of children wearing their aids full time who used aural/oral communication--an anticipated finding.

Table 142

Highest Level of Hearing-Aid Use, 1987-1991

	Less than 1/4 Time	1/4 to 1/2 Time	1/2 to 3/4 Time	3/4 to Full Time	Full Time	Total
			Overall Frequencies and Percentages			
N	130	111	153	222	860	1476
%	8.8	7.5	10.4	15.0	58.3	100
			Time (in Months) to Attain Highest Level of Hearing Aid Use			
M	2.3	3.3	4.6	4.4	2.8	3.2
SD	3.9	5.0	5.3	5.4	4.5	4.8
Mdn	0	1	3	3	1	1
			Severity of Unaided Hearing Loss--Percentages of Children *			
No Loss	.3	.3	.1	.1	.4	1.2
Mild	.6	.4	.6	.7	4.1	6.5
Moderate	1.0	1.2	2.1	3.9	12.7	20.9
Severe	3.4	3.6	4.6	6.5	27.8	46.0
Profound	3.2	1.8	2.9	4.0	13.3	25.3
Overall	8.6	7.3	10.4	15.3	58.4	100.0
			Type of Hearing Loss--Percentages of Children **			
Conductive	.6	.4	.2	.2	1.7	3.1
Sensorineural	7.6	6.3	8.5	13.3	53.5	89.3
Mixed	.8	.6	1.5	1.3	3.5	7.6
Overall	9.0	7.3	10.3	14.8	58.7	100.0
			Communication Methodology--Percentages of Children ***			
A/O	1.0	1.7	2.5	4.1	27.4	36.7
T.C.	6.6	4.8	7.3	10.4	33.3	62.5
Other	.1	.2	0	.2	.3	.8
Overall	7.7	6.7	9.9	14.7	61.1	100.0

Note:

* Cramer's V = .08, based on N = 1390. Severity of hearing loss was not associated with highest level of hearing-aid use.

** Cramer's V = .09, based on N = 1440. Type of hearing loss was not associated with the highest level of hearing-aid use.

*** Cramer's V = .16, based on N = 1146. Communication methodology was associated with the highest level of hearing-aid use, but the association was small.

Threshold Improvement

Another measure of program effectiveness is the amount of amplification that the children gain from wearing their hearing aids. In Table 143 we present the mean threshold improvement by hearing-loss-severity levels. We calculated threshold improvement by subtracting the aided threshold level from the unaided threshold level. Because parent advisors did not report aided threshold levels as consistently as they did unaided threshold levels, we have threshold-improvement data for only 2,323 of the children. As expected, children with profound hearing losses obtained the largest threshold improvements from amplification.

Table 143

Mean, Standard Deviation, and Median Decibel Improvement from Unaided to Aided Hearing Thresholds by Severity of Loss, 1979-1991

Severity	M	SD	Mdn	N
No	3.4	4.1	1.5	14
Mild	15.3	8.8	15	157
Moderate	25.8	10.7	25.5	458
Severe	30.8	15.8	32	1107
Profound	37.7	20.5	40	587
Total	30.3	17.0	30	2323

Auditory Development

Although hearing aids made sound audible for many of the children, there was no guarantee that the children would develop the needed perceptual skills for hearing language. Because the children's amplification tolerance and discrimination abilities were unknown and because the hearing aids were not always fully operational due to dead batteries, plugged earmolds, or broken aids, the children needed assistance with developing auditory perceptual abilities. The goal of the home auditory program was for the children to develop the underlying auditory skills necessary for speech development and to establish the auditory/motor associations that underlie speech. The parents were taught to provide stimulation activities designed to develop auditory memory for sound patterns and pitch changes, as well as to develop vowels and consonants.

The 11 auditory levels of the program (Appendix A) were developmentally sequenced. Parent advisors were instructed to begin recording developmental levels after the auditory program was initiated and to write down the number of the highest auditory level the child achieved during the week.

We present, as part of Table 144, the mean and median auditory levels for the children at the beginning of their programs and at the time of last entry on the data sheets and the mean and median amounts of time that it took to attain the highest levels. Given the skewed distributions, the median is a better estimate of average performance than the mean. Fifty percent of the children began the home auditory program at Level 2 or lower and within a median of three months' time had attained Level 7.

In Table 145, we present the frequencies and percentages of children by the highest levels of auditory development attained and the mean and median time that it took to attain the levels of auditory development. For example, for 200 of the children, Level 2 was the highest auditory level that had been attained; on average, it took 2.2 months to attain Level 2. For Auditory Levels 1 through 10, increased levels of development were associated with increased time to attain (median times from 0 to 7 months). However, for

Table 144

Overall Means, Standard Deviations, and Medians for Child Auditory, Communication-Language, and Vocabulary Levels and Acquisition Times, 1987-1991

	Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
	Auditory (11 Levels) N=1421			Communication-Language (12 levels) N=1632			Vocabulary (8 Levels) N=1564		
Beginning Level	3.2	3.1	2	4.0	2.9	3	2.4	2.1	1
Ending Level	6.4	3.5	7	7.2	3.0	8	4.5	2.6	5
Difference	3.2		5	3.2		5	2.1		4
Time Interval (in Months) to Attain Ending Level	5.2	5.8	3	6.5	6.7	5	6.4	6.6	5

Table 145

Frequencies and Percentages of Children and Means, Standard Deviation and Median Time (in Months) to Attain Each Level of Auditory Development, 1987-1991

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10	Level 11	Total
N	83	200	105	137	127	57	145	88	75	77	327	1421
%	6	14	7	10	9	4	10	6	5	5	23	100
M	1.6	2.2	3.6	4.5	6.1	6.6	6.1	8.5	7.7	8.3	5.5	
SD	2.5	3.8	4.4	4.4	5.7	6.6	5.6	6.8	6.3	6.4	6.0	
Mdn	0	1	2	3	5	5	5	7	6	7	4	

Note: Depicted here are the numbers of children by highest level of auditory development attained. The mean times reported are not cumulative. For example, for children for whom Level 3 was the highest level attained, the average time to attain that level was 3.6 months (median = 2 months). Although times are not cumulative, the means indicate that it took approximately 1 to 1 1/2 months additional time to attain the next level of auditory development.

Level 11 (speech use), that pattern did not hold. For 23% of the children, Level 11 was attained in a median time of four months.

Communication-Language Development

Communication begins developing at birth through natural interactions and conversations between the child and the parents. The child communicates his/her intentions through a variety of gestures, facial expressions, and vocalizations. Parents must be sensitive to the child's messages and respond to them effectively. The goals of the home communication program were that the parents (a) understand how communication develops and its importance for language development; (b) develop the essential skills to foster and stimulate effective parent/child communication; (c) monitor and evaluate their child's communication behaviors; and (d) arrive at a communication methodology decision appropriate for the child and the entire family.

The 12 communication-language levels of the program (see Appendix A) were developmentally sequenced. Parent advisors were instructed to begin recording developmental levels after the communication program was initiated and to write down the number of the highest communication-language level the child achieved during the week.

We present, as part of Table 144, the mean and median communication-language levels for the children at the beginning of their program and at the time of last entry on the data sheets and the mean and median amounts of time that it took to attain the highest levels. Given the skewed distributions, the median is a better estimate of average performance than the mean. Fifty percent of the children began the home communication program at Level 3 or lower and within a median of five months' time had attained Level 8.

In Table 146, we present the frequencies and percentages of children by the highest levels of communication-language development attained and the mean and median time that it took to attain the levels. For Communication-Language Levels 1 through 11, increased levels of development were associated with increased time to attain (median times from 0 to 7 months). However, for Level 12 (uses compound/complex sentences), that pattern did not hold. For 6% of the children, Level 12 was attained in a median time of four months.

Table 146

Frequencies and Percentages of Children and Means, Standard Deviation, and Median Time (in Months) to Attain Each Level of Communication-Language Development, 1987-1991

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Level 9	Level 10	Level 11	Level 12	Total
N	41	66	118	132	205	67	180	146	215	219	151	93	1633
% of children	3	4	7	8	13	4	11	9	13	13	9	6	100
M	1.7	2.4	1.9	3.8	4.8	6.1	6.6	8.2	8.3	9.0	9.8	6.2	
SD	3.1	4.0	2.3	4.1	4.7	6.1	5.7	7.0	7.7	7.7	7.4	6.8	
Mdn	0	1	1	3	3	4	5	7	6	7	7	4	

Note: Depicted here are the numbers of children by highest level of communication/language development attained. The mean times reported are not cumulative. For example, for children for whom Level 4 was the highest level attained, the average time to attain that level was 3.8 months (median = 3 months). Although times are not cumulative, the means indicate that it took approximately 1 to 1 1/2 months additional time to attain the next level of communication/language development.

Vocabulary Development

As a part of the communication program, vocabulary development was monitored. Eight vocabulary intervals were provided on the SKI*HI Data Sheets and parent advisors are instructed to write down the number of the appropriate vocabulary interval. Specific instructions as to what constitutes a new word were provided in the SKI*HI manual on pages 81-82. The general instructions were to count as a new word a morpheme that was distinguishable as a word and had been used spontaneously (not imitatively) by the child more than once.

We present, as part of Table 144, the mean and median vocabulary intervals for the children at the beginning of their program and at the time of last entry on the data sheets and the mean and median amounts of time that it took to attain the highest intervals. Again, given the skewed distributions, the median is a better estimate of average performance than the mean. For 50% of the children, the median initial vocabulary interval was one. Within a median of five months' time, 50% of the children had attained Interval 5.

In Table 147, we present the frequencies and percentages of children by the highest vocabulary interval attained and the mean and median time that it took to attain the intervals. For Intervals 1 through 7, increases in vocabulary were associated with increased time to attain (median time from 0 to 9 months). However, for Interval 8 (201 to 300 words), that pattern did not hold. For 20% of the children, Interval 8 was attained in a median time of six months.

Table 147

Frequencies and Percentages of Children and Mean, Standard Deviation, and Median Time (in Months) to Attain Each Vocabulary Level, 1987-1991

	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7	Level 8	Total
N	285	183	178	124	140	172	179	305	1566
% of children	18	12	11	8	9	11	11	20	100
M	3.1	4.8	5.5	6.3	7.9	8.4	10.3	7.2	
SD	5.0	5.5	5.7	5.4	6.7	7.3	7.0	7.1	
Mdn	0	3	4	5	7	6	9	6	

Note: Depicted here are the numbers of children by highest level of vocabulary development attained. The mean times reported are not cumulative. For example, for children for whom Level 2 was the highest level attained, the average time to attain that level was 4.8 months (median = 3 months). Although times are not cumulative, the means indicate that it took approximately one month additional time to attain the next level of vocabulary development.

Parent Outcomes

As with the child-outcome data, the parent-outcome data were coded into the National Data Bank only for the 1987 through 1991 program years. The data were obtained from the lower portion of the SKI*HI Data Sheets (Appendix A), where parent advisors recorded session-by-session observations under the section entitled Parent Data. Again, for the 1987 through 1991 program years, data for a total of 2,178 children were submitted. However, not all parent advisors completed this lower portion of the data sheet, or they recorded data only monthly, rather than session-by-session. Furthermore, based on the choice of communication methodology for the child, parents were monitored for aural/oral skills or total communication skills, not both. Finally, not all parents needed the cognition programming skills. Consequently, the sample sizes for the parent-outcome data are smaller than those obtained for the demographic data. We will report here the parent outcomes for hearing aid, auditory, communication, aural/oral, and total communication skills.

Hearing-Aid Skills

A hearing-aid competency test was provided in the SKI*HI manual on pages 231-234. Parent advisors were instructed to write down, only once, the number of the home visit during which the parent received a score of 80-100% on the hearing-aid competency test. The mean visit number at which 80-100% competency was achieved was 11 (sd = 8), with a median of 9.

Auditory Skills

Parent advisors were instructed to begin recording after the initiation of the Auditory Program the number(s) of all new auditory skills acquired by the parent(s) during the home visit or preceding week. Eleven skills were possible (see Appendix A). Specific instructions for determining parent progress were found on page 71 of the SKI*HI manual. If the parent achieved no new auditory skills during a particular week, the PAs were instructed to leave the space for the current week blank.

For the 1987-1991 program years, data coders counted the number of auditory skills recorded by the PAs on the data sheets. The mean number of auditory skills acquired was 4.6 (median = 4), and these were acquired by the parents, on average, in 6.4 months (median = 5 months) (Table 148).

Communication Skills

To document communication-skill acquisition, recording began after the initiation of the Communication Program. The same instructions for recording auditory skills applied to the recording of communication skills. Fifteen communication skills were possible (see Appendix A). The mean number of communication skills acquired was 8.1 (median = 8), and these were acquired, on average, in 6 months (median = 5 months) (Table 148).

Aural/Oral Skills

Recording began after the initiation of the Language Stimulation Program: Aural/Oral. Again, the same instructions applied for recording aural/oral skills acquired by the parents. Nine aural/oral skills were possible (see Appendix A). The mean number of aural/oral skills acquired was 4.7 (median = 5), and these were acquired, on average, in 5 months (median = 4 months) (Table 148).

Table 148

Means, Standard Deviations, and Medians for Number of Parent Skills Acquired and Time in Months to Acquire Skills, 1987-1991

	Number of Skills				Time in Months			
Skill	M	SD	Mdn	N	M	SD	Mdn	N
Auditory (11 skills)	4.6	3.1	4	1327	6.4	5.9	5	1057
Communication (15 skills)	8.1	5.0	8	1493	6.0	5.1	5	1299
Aural/Oral (9 skills)	4.7	2.9	5	702	5.0	4.7	4	547
Total Communication (20 skills)	6.7	5.0	6	670	6.4	5.7	5	561
Cognition (12 skills)	4.4	3.4	3	265	4.6	4.9	3	200

Total Communication Skills

Recording began after the initiation of the Language Stimulation Program: Total Communication. Again, the same instructions applied for recording total communication skills acquired by the parents. Twenty total communication skills were possible (see Appendix A). The mean number of total communication skills acquired was 6.7 (median = 6), and these were acquired, on average, in 6.4 months (median = 5 months) (Table 148).

Cognition Skills

Recording began after the initiation of the Cognition Program, with the same instructions for recording as those for the auditory skills. Twelve cognition skills were possible (see Appendix A). The mean number of cognition skills acquired was 4.4 (median = 3), and these were acquired, on average, in 4.6 months (median = 3 months) (Table 148).

Follow-up Data

Prior to presenting the follow-up data, we present the mean and median ages for graduation from the home-based program. Although parent advisors failed to report this information consistently, we do have data for 27% (*N* = 1,481) of the children, providing an estimate of graduation age for the total population of children. The mean graduation age was 43 months (*sd* = 13), with a median of 42 months.

One outcome variable of particular interest to parents and educators was the placement of children with hearing impairments upon completion of home-based programming. Before the large-scale implementation of early identification and home-intervention procedures, children with hearing impairments were typically identified close to school age (3 to 5 years of age) after they failed to learn language. Because of the substantial language deprivation that had occurred by that time, these children were usually placed in residential or day schools for the deaf, where they were taught by highly structured language-teaching methods. A national demographic study conducted by Gallaudet College for the 1968-1969 years indicated that 64% of all children with hearing impairments who were less than 6 years of age were placed in residential programs (typically state schools for the deaf) or day schools for the deaf. Only 7% of such children were in regular school classes and/or received special education services on a part-time basis. The remaining 29% of the children in the Gallaudet study attended special preschool programs that were not part of a larger system, such as a state school for the deaf. More recent studies have been conducted on the placement of children with hearing impairments (Schildroth, 1986; Singer, Butler, & Walker, 1986), but information specifically related to the placement of children who have had early home-based intervention has not been available.

For this investigation, follow-up data were collected from site personnel using the questionnaire discussed previously in Chapter 6 (see Appendix E). Responses were obtained for 1,404 children for the program years 1986-1989 only.

Placement Immediately After Home-Based Programming

In Table 149 we present the frequencies and percentages of children for the various placements. The largest percentage (39%) of the children were placed in self-contained classrooms for the hearing impaired, with only 15% placed in a day school for the hearing impaired, and 2% placed in residential programs. Twelve percent were placed in mainstreamed/integrated classrooms and another 2% were placed in Head Start/Home Start integrated preschools. Small percentages of the children received other services (6%), individual speech/language/auditory services (6%), or transition-program services (< 1%). For 10% of the children (n = 146), the site personnel did not know what placement occurred immediately after home-based programming.

Table 149

Frequencies and Percentages of Children for Placement After Home Programming, 1986-1989

Placement	N	%
Self-Contained Class for the Hearing Impaired	547	39
Day School for the Hearing Impaired	211	15
Mainstreamed/Integrated Classroom	167	12
Other Services	83	6
Class for Mentally Handicapped =12		
Class for Severely Impaired =5		
Non-Categorical Class =46		
Developmentally Delayed Class =7		
Other =13		
Individual Speech/Language/Auditory Services	79	6
Head Start/Home Start/Preschool	34	2
Residential Program	31	2
In Home-No Services	22	2
Day Care	8	1
Transition Program	3	<1
Aid In Class =1		
Itinerant Teacher =1		
Callier =1		
Hasn't Graduated	73	5
Unknown/Not Reported	146	10
Total	1404	100

Current Placement

For current program placement for these same children, a slightly different pattern of placement was observed (Table 150). For 21% of the children, site personnel reported a public-school placement (13%) or a mainstreamed/integrated-classroom placement (8%). Twelve percent of the children were placed in self-contained classes for the hearing impaired within a public school setting. Smaller percentages were reported for day schools for the hearing impaired (11%), day schools for the deaf and/or blind (8%), and residential programs for the deaf (3%). For 24% of the children (n = 337), the site personnel either did not know the child's placement or did not respond to the question.

Internal and External Validity

We have presented evidence that the program results were attributable to SKI*HI intervention. Possible rival hypotheses to program effectiveness that were studied and ruled out were: (a) Testing: The testing effect includes teaching to the test or the practice effect. SKI*HI children did not take a test per se. Instead, their communication skills were observed in their home environment by the PA and the parent, and communication level was recorded on the LDS testing form by the PA. Additionally, SKI*HI children were not "taught the test". The PA taught the parents auditory, communication, cognitive, aural/oral or total-communication facilitation skills. The parents then provided the children with stimulation throughout the day in the home environment; they did not teach the test. (b) Maturation: Children consistently demonstrated greater average gains than would be expected due to maturation alone, and the rate of development during intervention was greater than developmental rate prior to intervention. (c) Selection: The threat of selection to the internal validity of these findings was not applicable, because there was no control or comparison group. (d) Attrition: All children for whom there was both pre- and posttest data were used; there is no reason to expect that SKI*HI children [a] who dropped out of the program prior to posttest or [b] who entered the program mid-year and were only assessed

Table 150

Frequencies and Percentages of Children by Current Placement, 1986-1989

Current Placement	N	%
Public School	188	13
Self-Contained Class for Hearing Impaired	163	12
Day School for Hearing Impaired	157	11
Mainstreamed/Integrated Class	119	8
Day School for Deaf and/or Blind	111	8
Self-Contained Plus Other Classroom	44	3
Residential Program for the Deaf	42	3
Non-Categorical Self-Contained Classroom	38	3
Preschool for the Hearing Impaired	33	2
Preschool Plus Other Services	34	2
Mainstreamed Plus Other Services	24	2
Special Individual and Group Program Combinations	11	1
In Home-No Services	11	1
Program for Multiply Handicapped	10	1
Deceased	9	1
Not Graduated	73	5
Do Not Know/Moved	275	20
No Response/Cannot Tell	62	4
Total	1404	100

once during the year or [c] for whom PAs did not report posttest data differed systematically from those who had both pre-and posttest data; (e) Instrumentation: Parent advisors were trained to collect demographic, child, and parent data, and instructions for completing the SKI*HI Data Sheet were provided in the SKI*HI manual for PAs. The instrumentation question of interest was whether the PAs' scores were reliable and valid (i.e., were the PAs affected by knowing the children?). Inter-examiner agreement data were available for scores from children used in the LDS test-validation study (Tonelson & Watkins, 1979). And intercoder-agreement data were reported in Chapter 4, indicating that coder agreement was high. (f) History: It is possible that other events, in addition to SKI*HI treatment, accounted for some of the gains. For 49% of the children, other services (e.g., preschool, mental health, social, or speech therapy) were obtained by the parents of children during SKI*HI programming. However, such services, as needed, were part of the support services provided to SKI*HI children (see Figure 1). (g) Regression: On average, SKI*HI children's LDS developmental quotients were more than two standard deviations below the mean of 100 at the pretest, so some regression toward the mean would be expected at posttest. A comparison was made of mean developmental gain for children whose quotients were more than one standard deviation below the mean at pretest with the mean developmental gain for those children whose quotients were higher than one standard deviation above the mean at pretest. For the receptive LDS scores, the children with low pretest quotients had an average gain of 12.6 months and the children with high pretest quotients had an average gain of 11.3 months. For the expressive LDS scores, similar findings were obtained. The children with low pretest quotients had an average gain of 11.8 months and the children with high pretest quotients had an average gain of 11.1 months. The gains were quite similar for the children whether their quotients were high or low at the pretest. Even for children with high quotients at pretest, whose posttest scores would have regressed in a negative direction, mean gains were still substantial.

With respect to external validity, the generalizability of program results has clearly been well established. SKI*HI has been implemented in widely diverse settings with racially and culturally different families.

Summary

Some findings from this chapter will be highlighted here.

1. The relationships among the treatment variables (i.e., treatment amount, treatment density, and communication methodology) and demographic variables (presence of other handicaps, severity of hearing loss, age at onset of hearing loss, language spoken in the home, and presence of parental hearing loss) were all small.
2. Forty-nine percent of the children were receiving services in addition to the home-based program. The vast majority of these children were receiving educational services (e.g., preschool).
3. Overall, pre- to post-developmental gains in receptive and expressive language were statistically significant and educationally important, with large standardized mean differences. On average, SKI*HI children made one month of language gain for every month of intervention (medians = 1.3 months of expressive language gain per month of treatment and 1.8 months of receptive language gain per month of treatment).
4. Overall, the differences between actual posttest means and predicted posttest means were statistically significant, with the actual posttest means higher than what was predicted based on maturation alone.
5. Overall, the median PCIs were large, with a rate of development during intervention that was nearly twice the rate of development prior to intervention.
6. Median PCIs were largest for children without an additional handicap.
7. For the receptive language scale, median PCIs were largest for children with a sensorineural hearing loss and for children with

severe hearing losses.

8. For both scales, median PCIs were largest for children whose cause of hearing loss was fever or infection and for children whose age at onset was 2 to 3 years.
9. For both scales, median PCIs were smallest for children whose home language was ASL, reflecting the fact that such children were identified at an earlier age than children from homes in which other languages were used and children from homes in which neither parent was hearing impaired (see Chapter 6).
10. Median PCIs were largest for children who received treatment amounts of 12 months or less and for children who received treatment four times per month.
11. Median PCIs were largest for children using total communication.
12. The regression of pretest scores on pretest chronological age resulted in regression equations used to estimate each child's amount of growth due to maturation alone. Overall, the mean gains from pre- to posttest that were associated with maturation were 7.7 and 7.9 months for the expressive and receptive scales, respectively. The mean gains over and above the gains associated with maturation were 4.2 and 4.9 months for the expressive and receptive scales, respectively.
13. The children evidenced increased full-time hearing aid use and increased auditory, communication-language, and vocabulary developmental levels during SKI*HI programming.
14. The parents evidenced increased ability to manage their children's hearing handicap, to stimulate communication-language skills, and to promote their children's cognitive development during SKI*HI programming.
15. Immediately after home-based programming, 39% of the children were placed in self-contained classrooms, with only 15% placed in day schools for the hearing impaired and 2% placed in residential

programs.

16. The data for current program placement indicate that 21% of the children were in a public school placement or a mainstreamed/integrated classroom, with 12% placed in self-contained classes for the hearing impaired. Nineteen percent of the children were placed in day schools and 3% were in residential programs for the deaf.

Chapter Concluding Statement

In this chapter, we have presented the major results from the analyses of the data from our population of children, as well as descriptive statistics for the treatment variables. The findings demonstrate how SKI*HI programming meets the needs of young hearing-impaired children and their families. The results are positive! SKI*HI does equip families to manage their children's handicap, communicate meaningfully with their children, and promote their children's development, thus enabling hearing-impaired infants and toddlers to make substantial developmental growth.

CHAPTER 8

SUMMARY, CONCLUSIONS, AND DISSEMINATION OF FINDINGS

SKI*HI is a home-based program for infants and young children with hearing impairments and for their families. The major goals of the program are to identify hearing-impaired children as close to birth as possible and to provide them and their families with complete home programming that will facilitate development. The delivery model for the program includes identification/screening services, home-visit services, support services, and program management. The "heart" of the service is provided by a parent advisor, who makes weekly home visits to families. The parent advisor works closely with parents and with other members of a multi-disciplinary team to assess, plan, and provide appropriate home-based services for all family members.

In this chapter a brief overview of the purpose and design of the study is provided. Next, the results and conclusions are summarized. Finally, dissemination activities that have occurred and that are planned will be reported, followed by a concluding statement.

Study Overview

As noted in Chapter 1, previous reports on the demographics of children with hearing impairments, identification procedures, and effectiveness of home-based programming have been limited to findings for small numbers of children being served in specific regions over a brief time span. The SKI*HI National Data Bank was initiated in 1979 and by the completion of this investigation contained information on more than 5,000 hearing-impaired children (ages 0 through 5 years of age) and their families. The problem addressed by this research project was the lack of a complete analysis and synthesis of the information in the National Data Bank for educators of children with hearing impairments and for researchers.

Purpose

The general purpose of the project was to provide research findings on critical areas of home-based programming for hearing-impaired children and their families. The specific objectives were (a) to describe the demographic characteristics of the children who received home-based intervention and to study the relationship of these characteristics with child achievement; (b) to study the effectiveness of identification procedures for hearing loss; and (c) to investigate aspects of home-based intervention, including amount, intensity, and time of program start, on the language development of infants and young children with hearing impairments.

Design

A pretest/posttest, single-group design was used rather than a comparison-group design. To control for maturation, the pre/post gains of the children were studied using predictive models.

Sample

From July 1979 through June 1991, personnel from 143 different agencies, representing 30 states and one Canadian province, submitted data on 5,178 hearing-impaired children (ages 0 through 5 years) and on their families. All data submitted to the National Data Bank were included in the analyses.

For the identification-procedure data and for the follow-up data related to placement after SKI*HI, personnel from 45 different agencies, representing 15 states, submitted data for 1,404 children. These data were collected for the July 1986 through June 1989 program years.

Instruments and Procedures

Demographic, test, and parent/child data were collected using the SKI*HI Data Sheet. Identification-procedure and program-placement data were collected using a questionnaire specifically developed for the study. The standardized language-assessment instrument was the Language Development Scale.

Data Collection

Demographic, test, and parent/child data were collected by trained parent advisors and were submitted to the site coordinators, who then submitted the data to the National Data Bank. Identification-procedure and program-placement data were collected by the site coordinators and then were submitted to the National Data Bank. All data coding and entry was checked for accuracy.

Data Analysis

For demographic, identification, and treatment variables, descriptive statistics and two-way frequency tables were presented. The analyses of child progress controlled for maturation through the use of four different, but related, approaches: (a) mean posttest scores were compared with mean predicted posttest scores; (b) intervention developmental rate was compared with pretest developmental rate using PCIs; (c) growth associated with maturation was compared with the growth over and above maturation using value-added analysis; and (d) the optimal linear combination of treatment variables for predicting language development rate during intervention was determined using multiple regression.

Results and Conclusions

Demographic

The demographic characteristics studied were gender, race, presence/absence of other handicapping conditions, type of hearing loss, severity of hearing loss, cause of hearing loss, age at onset of hearing loss, language spoken in the home, and presence/absence of parent with a hearing loss. A summary of the findings follow:

1. Gender. Overall, 55% of the children were males and 45% were females. The relative percentages varied only slightly across the program years. Only small coefficients were obtained describing the relationships between gender and the other demographic variables.
2. Ethnicity. Overall, 72% of the children were Caucasian. The remaining 28% were primarily of African-, Spanish-, Native-, or Asian-American descent. The relative percentages of each ethnic group did not differ significantly across the program years. Only small coefficients were obtained describing the relationships between ethnicity and the other demographic variables.

3. Additional handicap. Overall, 25% of the children had an additional handicapping condition. Little variation in the percentage was observed across the program years. A low association between presence of an additional handicap and cause of loss was observed. Not surprisingly, children whose cause of loss was a birth defect or a child syndrome tended to have additional handicapping conditions.

4. Type of hearing loss. The vast majority (82%) of the children had sensorineural hearing losses. The relative percentages for the types of hearing loss varied little across the program years. A low association between type of hearing loss and severity of hearing loss was observed. Not surprisingly, children with no loss and mild losses tended to have conductive hearing losses. Also, a moderate association between type of hearing loss and cause of loss was observed. Children whose cause of loss was middle-ear problems or birth defects (e.g., atresia) tended to have conductive hearing losses.

5. Severity of hearing loss. Overall, the mean and median hearing thresholds were 74 dB and 75 dB, respectively; 50% of the children had hearing losses in the severe-to-profound range. The relative percentages for the hearing-loss-severity levels varied little across the program years. As mentioned above, in Number 4, a small relationship between severity of hearing loss and type of loss was observed. In addition, a small relationship between severity of hearing loss and cause of hearing loss was observed. Not surprisingly, children whose cause of loss was middle-ear problems or birth defects tended to have almost no loss or mild losses.

6. Cause of hearing loss. The cause of hearing loss was unknown for 50% of the children. Of the known causes of hearing loss, meningitis and heredity were the most frequently reported causes.

Approximately 20% of the hearing losses, from both known and unknown causes, occurred after birth. The relative percentages for the causes of hearing loss varied little across the program years. As mentioned above, a low degree of association between cause of hearing loss and presence of other handicaps was observed, as well as a moderate association between cause of hearing loss and type of hearing loss and a low association between cause of hearing loss and severity of loss.

7. Age at onset. For 96% of the children, the age at onset was two years or less. The relative percentages for the age-at-onset levels varied little across the program years. The association between age at onset and cause of hearing loss was moderate, reflecting fewer children with onset of hearing loss at birth whose hearing losses were caused by meningitis, and fewer children with onset of hearing loss after birth whose losses were caused prenatal factors.

8. Language spoken in the home. For 90% of the children, the language spoken in the home was English. The relative percentages for the languages varied little across the program years. The association between language spoken in the home and cause of hearing loss was low, reflecting the larger-than-expected frequencies of children whose cause of hearing loss was heredity and who came from homes in which ASL was the primary language. The association between language spoken in the home and ethnicity was low, reflecting the finding that Spanish was the language spoken in the homes of children who were Spanish-American. Neither finding was surprising.

9. Parental hearing loss. For 9% of the children, one or both parents were also hearing impaired. The relative percentages of parental hearing loss varied little across the program years. The association between presence of parental hearing loss and cause of

loss was moderate, reflecting the larger-than-expected frequencies of children with a hearing-impaired parent and for whom heredity was the cause of hearing loss. Also, the association between presence of parental hearing loss and language spoken in the home was moderate, reflecting larger-than-expected frequencies of children with a hearing-impaired parent whose primary language in the home was ASL. Again, neither of these findings was surprising.

The relationships between each of the demographic variables and pretest expressive and receptive language quotients were also studied. Overall, the mean expressive language pretest quotient was 56; the mean receptive language pretest quotient was 60. The relationships are summarized here.

1. Gender. Males and females did not differ significantly with respect to pretest expressive and receptive language quotients.
2. Ethnicity. For the expressive scale, Caucasian children obtained significantly higher mean pretest quotients than African- or Spanish-American children. For the receptive scale, Caucasian children obtained significantly higher mean pretest quotients than African-, Asian-, or Spanish-American children.
3. Other handicap. Children without an additional handicap obtained significantly higher mean pretest quotients than children without additional handicaps.
4. Type of hearing loss. Children with conductive hearing losses obtained significantly higher mean pretest quotients than children with sensorineural or mixed losses.
5. Severity of hearing loss. Children with no losses, mild losses, and moderate losses obtained significantly higher mean pretest quotients than children with severe or profound hearing losses.
6. Cause of hearing loss. For the expressive scale, children whose hearing losses were caused by heredity or by a syndrome obtained the highest mean pretest quotients. For the receptive scale,

children whose hearing losses were caused by heredity, middle-ear infections, or by a syndrome obtained the highest mean pretest quotients.

7. Age at onset. Children whose onset of hearing loss was at birth obtained significantly higher mean pretest quotients than children whose onset was between birth and one year of age.

8. Language spoken in the home. Children whose home language was ASL obtained significantly higher mean pretest quotients than children whose home language was Spanish, English, or other.

9. Presence of hearing-impaired parent. Children for whom one or both parents had a hearing loss obtained significantly higher mean pretest quotients than children without a hearing-impaired parent.

10. Correlation ratios (Eta^2) which indicate the proportion of variability among the pretest quotients associated with each of the demographic variables were small, leading to the conclusion that there was little relationship between pretest quotients and the demographic variables.

11. Standardized mean differences (SMDs), which indicate the magnitude of the differences between means and are independent of sample size (unlike indices of statistical significance), were small to medium for the most part. For example, the mean pretest quotients of children without additional handicaps were approximately 1/3 of a standard deviation larger than the mean pretest quotients of children with additional handicaps. Although this difference was statistically significant, the difference between the means was, from an educational perspective, very small.

12. The only large SMDs were obtained for children whose home language was ASL as compared to children whose home language was Spanish, English, or other. The largest SMD (.94) described the difference between the mean pretest quotients of children whose home language was ASL and children whose home language was Spanish--a difference

of nearly one full standard deviation. It should be noted that the standard deviations were largest for children whose home language was ASL, indicating greater variability among the pretest quotients than for the children whose home language was Spanish.

Identification Procedures

The identification variables studied were identification age, program-start age, hearing-aid-fit age, suspicion-to-identification time interval, identification-to-program-start time interval, suspicion-to-program-start time interval, identification procedure, who suspected the hearing loss, and cause of suspicion. A summary of the findings follow:

1. Overall, the median identification age was 17 months, with a median hearing-aid fit age of 22 months and a median program-start age of 25 months.
2. For children with additional handicapping conditions, the median identification age was 12 months, with a median hearing-aid fit age of 19 months and a median program-start age of 22 months.
3. For profoundly impaired children, the median identification age was 15 months, with a median hearing-aid-fit age of 19 months and a median program-start age of 21 months.
4. For children whose cause of hearing loss was a known risk factor or was visually apparent at birth, the median identification age ranged from 9 to 16.5 months; the median hearing-aid-fit age ranged from 17 to 19 months; and the median program-start-age ranged from 18 to 24 months.
5. For children whose age at onset was at birth or from birth to one year, the median identification age was 12 months, with a median hearing-aid-fit age of 18 months and a median program-start age of 21 months.
6. For children from homes in which ASL and signed English were the primary languages, the median identification ages were 8 and 13 months, respectively; the median hearing-aid-fit ages were 16 and

18.5 months, respectively; and the median program-start ages were 15 and 20.5 months, respectively.

7. For children with a hearing-impaired parent, the median identification age was 12 months, with a median hearing-aid-fit age of 19 months and a median program-start age of 21 months.

8. Overall, the median suspicion-to-identification time interval was 3 months, with a median identification-to-program-start interval of 4 months and a median suspicion-to-program-start interval of 9 months.

9. The median suspicion-to-identification time interval was smallest (1 month) for children whose cause of hearing loss was meningitis or defects at birth.

10. The median suspicion-to-identification time interval was also smallest (1 month), as was the median identification-to-program-start interval (2.5 months), for children whose age at onset was two years or older. The median suspicion-to-program-start interval was smallest (5 to 6 months) for children whose age at onset was one year or older.

11. The median identification-to-program-start time interval was largest (6 months) for children whose cause of loss was a syndrome.

12. The median identification-to-program-start time interval was also largest (6 months), as was the median suspicion-to-program-start time interval (13 months), for children from homes in which languages other than English and Spanish were spoken.

13. The median suspicion-to-program-start interval was largest (13 months) for children whose cause of hearing loss was conditions during pregnancy (e.g., prematurity) and birth trauma.

14. The majority of the hearing losses (60%) were first suspected by caregivers.

15. Earliest identification ages, program-start ages, and hearing-aid-

fit ages were associated with health/human-services and medical personnel.

16. The shortest time intervals between suspicion and identification were associated with medical and health/human-services personnel.

17. The median time interval from identification to program start was shortest for other specialists--85% of whom were audiologists.

18. The majority of the children were identified by people (caregivers, medical and health/human-services personnel, educators, and other specialists) rather than by screening procedures using behavioral audiometry, ABR, Crib-O-Gram, or middle ear/immittance.

19. Although no direct documentation was obtained, indirect evidence indicates that for Utah children, the high-risk register may have accounted for the large percentage of children who were identified by four to eight months of age.

20. Sample sizes were extremely small for the Crib-O-Gram, behavior audiometry, and middle-ear/immittance identification procedures. Consequently, no conclusive evidence can be presented regarding which procedures resulted in the youngest identification, program-start, and hearing-aid-fit ages or the smallest suspicion-to-identification, identification-to-program-start, and suspicion-to-program-start time intervals.

21. Using multiple-regression analyses, with all age and time-interval variables included in the procedure, only program-start age served as a predictor of pretest expressive and receptive language quotients. The multiple *R*s were low.

Program Effectiveness

The treatment variables studied were treatment amount, planned and actual treatment density, communication methodology, communication-methodology age, program-start-to-communication-methodology interval, and other non-parent/infant-program services. A summary of the findings follows:

1. The relationships among the treatment variables (i.e., treatment amount, treatment density, and communication methodology) and demographic variables (presence of other handicaps, severity of hearing loss, age at onset of hearing loss, language spoken in the home, and presence of parental hearing loss) were all small.
2. Forty-nine percent of the children were receiving services in addition to the home-based program. The vast majority of these children were receiving educational services (e.g., preschool).
3. Overall, pre- to post-developmental gains in receptive and expressive language were statistically significant and educationally important, with large standardized mean differences. On average, SKI*HI children made one month of language gain for every month of intervention (medians = 1.3 months of expressive language gain per month of treatment and 1.8 months of receptive language gain per month of treatment).
4. Overall, the difference between actual posttest means and predicted posttest means were statistically significant, with the actual posttest means higher than what was predicted based on maturation alone.
5. Overall, the median PCIs were large, with a rate of development during intervention that was nearly twice the rate of development prior to intervention.
6. Median PCIs were largest for children without an additional handicap.
7. For the receptive language scale, median PCIs were largest for children with a sensorineural hearing loss and for children with severe hearing losses.
8. For both scales, median PCIs were largest for children whose cause of hearing loss was fever or infection and for children whose age at onset was 2 to 3 years.
9. For both scales, median PCIs were smallest for children whose home

language was ASL, reflecting the fact that such children were identified at an earlier age than children from homes in which other languages were used and children from homes in which neither parent was hearing impaired (see Chapter 6).

10. Median PCIs were largest for children who received treatment amounts of 12 months or less and for children who received treatment four times per month.
11. Median PCIs were largest for children using total communication.
12. The regression of pretest scores on pretest chronological age resulted in regression equations used to estimate each child's amount of growth due to maturation alone. Overall, the mean gains from pre- to posttest that were associated with maturation were 7.7 and 7.9 months for the expressive and receptive scales, respectively. The mean gains over and above the gains associated with maturation were 4.2 and 4.9 months for the expressive and receptive scales, respectively.
13. The children evidenced increased full-time hearing aid use and increased auditory, communication-language, and vocabulary developmental levels during SKI*HI programming.
14. The parents evidenced increased ability to manage their children's hearing handicap, to stimulate communication-language skills, and to promote their children's cognitive development during SKI*HI programming.
15. Immediately after home-based programming, 39% of the children were placed in self-contained classrooms, with only 15% placed in day schools for the hearing impaired and 2% placed in residential programs.
16. The data for current program placement indicate that 21% of the children were in a public school placement or a mainstreamed/integrated classroom, with 12% placed in self-contained classes for the hearing impaired. Nineteen percent of the children were

placed in day schools and 3% were in residential programs for the deaf.

Dissemination of Findings

The general purpose of this project was to disseminate the research findings to educators of children with hearing impairments and to researchers. Following are the dissemination activities that have occurred and that are planned for the near future.

Dissemination Activities Accomplished

A letter (Appendix I) and an individualized site report (see Appendix J for an example) were mailed to key personnel representing the individual agencies and states that participated in the National Data Bank. A total of 130 reports were mailed.

A copy of the final report has been mailed to the ERIC Document Reproduction Service for citation in the ERIC database.

The following presentations have been made to date:

1. Presentation at the request of the Office of Special Education by the Project Director, Dr. Thomas C. Clark, at the National Meeting of State Directors of Special Education, Spring 1991, Washington, DC.
2. Presentation by the Project Director, Dr. Thomas C. Clark: Keynote address at the Southeast Regional Conference of Early Intervention Programs Serving Families of Children with Sensory Impairments, April 1992, Birmingham, AL.
3. Presentation by the Project Director, Dr. Thomas C. Clark: Summary data presented at the Southwestern Regional Conference of SKI*HI and INSITE Programs, August 1991, Durango, CO.
4. Presentation by the Project Director, Dr. Thomas C. Clark: Data presented at the North Central Regional Conference of Early Intervention Programs, July 1992, St. Paul, MN.
5. Presentation by the Project Director, Dr. Thomas C. Clark: Keynote address at the Texas Statewide Conference on Education of

the Deaf, August 1992, San Antonio, TX.

6. Presentation by Don G. Barringer, Assistant Director, SKI*HI Institute: Regular session at the Council for Exceptional Children, May 1992, Baltimore, MD.
7. Presentation by the Research Director, Dr. Carol J. Strong, at the Utah Preschool Conference, May 1991, SLC, UT.
8. Presentation by the Research Director, Dr. Carol J. Strong, to the Institutional Council of the Utah Schools for the Deaf and the Blind, Spring 1991, SLC, UT.
9. Presentation by the Research Director, Dr. Carol J. Strong, to the Utah Parent/Infant Program parent advisors, Spring 1991, Ogden, UT.

Dissemination Activities Planned

1. A miniseminar proposal was submitted by Dr. Carol J. Strong, Research Director, and was accepted for presentation at the American Speech-Language-Hearing Association (ASHA) conference in November 1992, San Antonio, TX.
2. During the next year, at least three articles will be written and submitted to refereed journals. These articles will focus on the three major thrusts of this research: demographics, identification procedures, and program effectiveness.
3. A color-slide presentation is currently being developed to facilitate presentation of the data at conferences.

Concluding Statement

The major accomplishments of SKI*HI were (a) that SKI*HI children showed higher rates of development during intervention than prior to intervention and greater gains in receptive and expressive language development than would be expected due to maturation alone (in addition to which they showed pre- to posttest developmental gains that were statistically significant and that yielded effect sizes indicating important practical effects); (b) that SKI*HI children showed increased auditory, communication-language, and vocabulary developmental levels and increased full-time hearing aid use; (c) that SKI*HI parents showed increased ability to manage their child's hearing handicap, communicate meaningfully with their child, and promote their child's cognitive development; and (d) that SKI*HI children were identified at an early age and began to receive home programming services promptly after identification.

We have summarized the demographic, identification-procedure, and program-effectiveness information in the National Data Bank. The data, submitted from throughout the United States and one Canadian province, represent children who were culturally and ethnically diverse. It is likely, then, that the findings reported here can be generalized to all children participating in SKI*HI home-based programming for whom data were not submitted to the National Data Bank. Generalizability of the findings beyond such children is left to the reader. In conclusion, then, this study has provided important information regarding the demographics, identification procedures, and program effectiveness of home-based programming for hearing-impaired children and their families.

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APPENDICES

Child's Name:____________________________

SKI*HI DATA SHEET

DEMOGRAPHICS-I

1. Site Prefix (3 letters)__________ 2. Child ID #__________ 3. Date of birth__________ 4. Sex__________ 5. Program Start Date__________ 6. Date of ID__________ 7. Other handicaps__________
8. Date Hearing Aid Fit__________ 9. One or Both Parents Deaf: Yes / No (circle one) 10. Date of Suspicion__________ 11. Type of Loss: Sensori-neural / conductive / mixed (circle one) 12. Cause of Loss__________
13. Date of "Cause" if Occurred after Birth__________ 14. Race__________ 15. Language Spoken in the Home__________

DEMOGRAPHICS-II (Fill in at program initiation and thereafter whenever additions/changes are made):

1. Hearing Loss (dB numerical values; use best ear; circle if ave. of 2 frequencies or less):

Test Date	Unaided dB	Test Date	Aided dB

2. Communication Methodology: Date Begun:

Diagnostic/prescriptive __________
Aural-Oral __________
Total Communication __________
Other __________ __________

3. Other Non-Parent Infant Program Services: Date Begun:

__________ __________
__________ __________
__________ __________
__________ __________
__________ __________

4. Frequency of Home Visits: Date Begun:

( ) twice a week __________
( ) once a week __________
( ) every other week __________
( ) other__________ __________

5. Graduation Date __________

TEST DATA (Write down scores and dates of tests)

LDS:

Test Date	RA	EA

(highest month in age interval)

Other Tests:

Test name	Test Date	Results

CHILD DATA (Slash item if no longer reporting. Leave blank if child not yet achieved.) (Visit #)	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___	#___
	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date
Time Hearing Aid Worn. Begin recording after H.A. Prog. initiated. Write # of appropriate time interval. See back. Discontinue (slash) when child achieves 100%.																	
Auditory Development Begin recording after Aud. Prog. initiated. Write highest level child achieves (1-11). See back.																	
Communication-Language Development Begin recording after Comm. Prog. initiated. Write highest level child achieves (1-12). See back. Write # of appropriate vocabulary interval. See back. Discontinue (slash) when child has over 300 words.	Communication-Language Level:																
	Vocabulary:																
PARENT DATA (Begin recording after each program initiated. Slash item if no longer reporting. Leave blank if not yet achieved.)	Hearing Aid Skills: Visit # parent achieves 80-100% on hearing aid competency test:__________																
New Auditory Skills acquired (1-11). See back.																	
New Communication Skills acquired (1-15). See back.																	
New Aural-Oral Language Skills acquired (1-8). See back.																	
New Total Communication Skills acquired (1-20). See back.																	
New Cognition Skills acquired (1-12) Optional. See back.																	

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SKI*HI Data Sheet Key

CHILD DATA

Time Hearing Aid Worn

1. Less than ¼ time
2. ¼ - ½ time
3. ½ - ¾ time
4. Over ¾ time
5. All of the time

(Discontinue reporting when child wears aid 100% of time or recommended hearing aid wearing time during any week.)

Auditory Development

1. Attending
2. Early Vocalizing
3. Recognizing
4. Locating
5. Vocalizing w / inflection
6. Distances / levels
7. Producing vowels / consonants
8. Environmental discrim. and comp.
9. Vocal discrim. and comp.
10. Speech discrim. and comp.
11. Speech use

Communication-Language Development

1. Aware of surroundings, faces and / or voices
2. Pre-babbles (coos, gurgles, etc.)
3. Babbles or gestures
4. Understands single words or signs
5. Uses single words or signs
6. Uses jargon
7. Understands 2 word or sign sequences
8. Uses 2 word or sign sequences
9. Understands 3-4 word or sign sequences
10. Uses 3-4 word or sign sequences
11. Understands compound / complex sentences
12. Uses compound / complex sentences

Vocabulary Interval

1. 0-5 words
2. 6-10 words
3. 11-20 words
4. 21-30 words
5. 31-50 words
6. 51-100 words
7. 101-200 words
8. 201-300 words

(Discontinue reporting when child has over 300 words.)

PARENT DATA

New Auditory Skills

1. Attending
2. Early vocalizing
3. Recognizing
4. Locating
5. Vocalizing w / inflection
6. Distance / levels
7. Producing vowels / consonants
8. Environmental discrim. and comp.
9. Vocal discrim. and comp.
10. Speech discrim. and comp.
11. Speech use

New Cognition Skills

Parent helps child:

1. Assimilate and accommodate (lesson 2)
2. Learn object permanence (lesson 3)
3. Develop goal direction (lesson 3)
4. Learn about space (lesson 4)
5. Learn about causality (lesson 4)
6. Integrate all senses (lesson 4)
7. Attach symbols to objects and mental representations (lesson 5)
8. Distance self from objects (lesson 5)
9. Engage in symbolic play (lesson 5)
10. Form concepts (lesson 6)
11. Learn about order (lesson 6)
12. Learn how to generalize (lesson 6)

New Communication Skills

1. Minimize background noise
2. Encourage child to explore and play
3. Serve as communication consultant
4. Use interactive turn-taking
5. Get down on child's level
6. Maintain eye contact / direct conversation
7. Use facial expressions
8. Use intonation
9. Use gestures
10. Touch child
11. Respond to child's cry
12. Stimulate babbling
13. Respond to communication intents
14. Use conversational turn-taking
15. Use meaningful conversation

New Language Stimulation Skills: Aural-Oral

1. Conversation in child care activities
2. Conversation in parent task activities
3. Conversation in child initiated activities
4. Conversation in parent directed activities
5. Selection of target words and phrases
6. Increased frequency
7. Reinforcement
8. Expansion
9. Naturalness

Total Communication

1. Use gestures (lesson 2)
2. Respond to baby's gestures (lesson 2)
3. Use t.c. telegrams (lesson 4)
4. Emphasize iconic, easily shaped, functional signs (lesson 4)
5. Increase frequency of functional signs (lesson 5)
6. Emphasizes signs appropriate for child's language and visual development (lesson 5)
7. Reinforce child's signing attempts (lesson 6)
8. Sign consistently to child in child care activities (lesson 7)
9. Sign consistently to child in parent task activities (lesson 7)
10. Sign consistently to child in child initiated activities (lesson 7)
11. Sign consistently to child in parent directed activities (lesson 7)
12. Sign consistently during home visit (lesson 8)
13. Sign consistently when child present but conversation not directed to child (lesson 9)
14. Use animation in t.c. (lesson 10)
15. Use speech effectively in t.c. (lesson 10)
16. Use affixes and noncontent signs (lesson 10)
17. Know how to get the child to watch the signer (lesson 10)
18. Know how to correct child's signing mistakes (lesson 10)
19. Know how to sign when hands are full (lesson 10)
20. Know how to involve reluctant family members, friends and relatives in t.c. (lesson 10)

Appendix B

Step-By-Step Guide to Completion and Submission of SKI*HI Data Sheet

Step 1

Complete Demographic Section I of SKI*HI Data Sheet at program initiation. Complete Demographic Section II at program initiation and thereafter when additions/changes are made.

Demographic Data - I. Parent advisor fills in Demographic - I (fixed data) only once at program initiation. All dates should be written in numbers: month/day/year. For example, a program start date of June 4, 1985 is written 6/4/85.

1. **Site Prefix:** Each SKI*HI replication agency is assigned a 3-letter prefix (for example, GAA is Georgia's prefix and NDX is North Dakota's prefix). Enter the site's assigned prefix.
2. **Child ID Number:** Each child in a program is assigned a 3 digit number (for example, the sixteenth child to be assigned a number in a particular program is 016). Enter the child's ID number.
3. **Birthdate:** Write birthdate in numbers. For example, a birthday of July 6, 1985 is written 7/6/85.
4. **Sex:** Write M for male, F for female.
5. **Program start date:** The program start date is the month, day and year that *any* parent-infant program services were first given by the SKI*HI program. Examples are the date the coordinator spends time on the first telephone contact, the day the parent advisor visits the home and collects background information, or the first date of any home visit.
6. **Date of ID:** Identification is defined as first report from an audiologist indicating a hearing loss.
7. **Other handicaps:** Check yes if the child has a handicap, other than a hearing loss, which has been professionally confirmed.
8. **Date hearing aid first fit:** Write the date in numbers (month,day, year) when an aid, either trial or permanent, was first fit by any agency.
9. **One or both parents deaf:** Circle yes if one or both parents living in the home are hearing impaired.
10. **Date of suspicion:** Suspicion: Record the date the parents first suspected the hearing loss. If parents did not suspect any hearing loss before formal identification, record the identification date.
11. **Type of loss:** Circle only one of the types. Mixed implies both sensori-neural and conductive types of loss.

12. **Causes of loss:** For cause write the one from the following list that best describes the cause of the hearing loss.

1) unknown
2) hereditary
3) maternal rubella, CMV, or other infections during pregnancy
4) meningitis
5) defects at birth
6) fever or infections in child
7) RH incompatibility
8) drugs during pregnancy
9) other conditions during pregnancy
10) middle ear problems or ENT anomalies
11) drugs administered to child
12) birth trauma
13) child syndrome
14) other (specify)

13. **Date of cause:** If cause occurred after birth (e.g., meningitis, infection, child's reaction to drugs, or middle ear problems), enter the date of occurrence. If hearing loss present at birth, leave blank.

14. **Race:** Write child's race from the following (parental provision of this information is optional):

1) Caucasian
2) Black
3) Oriental/Asian American
4) Spanish American
5) American Indian
6) other (specify)

15. **Language spoken in the home:** Indicate what primary language is spoken in the home from the following list:

1) English
2) Spanish
3) American Sign Language
4) Signed English System
5) other (specify)

Demographics - II.

Parent advisor fills in Demographics - II (changing data) at program initiation and thereafter whenever new information is available. Dates should be written in numbers: month/day/year.

1. **Hearing loss:** Report the hearing sensitivity of the child in numerical dB values. Do not use categorical words. Use the child's best ear. If the average of two frequencies or less is reported,

circle that number. If the average of three or more frequencies is reported, do not circle that dB value. Make sure to indicate test date in numbers: month/day/year.

2. **Communication Methodology:** When the child first enters the parent-infant program, check the communicative placement and give date. Diagnostic/Prescriptive refers to the first few months of the child's enrollment in the program when no decision has yet been made as to auditory or total communication placement. During this time, evaluation data is being collected to aid in making this decision. By the end of the Communication Program, a communication method decision should be made, if possible. The child then begins the Language Stimulation Program: Aural-Oral or the Language Stimulation Program: Total Communication. The parent advisor should be sure to note when the child changes from diagnostic-prescriptive to an aural-oral or a total communication language program. When the child is placed in or changed to a specific methodology, give the date the family begins to use that method with the child.

3. **Other Non-Parent-Infant Program Services:** List and date the initiation of other non-parent-infant program services (other than diagnostic) given to the child and family while child is in the parent- infant program. List services by category as shown below:

    a. educational (e.g., preschool, day care, kindergarten)
    b. speech and hearing therapy
    c. mental health (e.g., parent counseling, child therapy)
    d. health (e.g., free clinics, public health nurse, nutritional services)
    e. social (e.g., welfare, aid to dependent children, family services)
    f. services for mentally retarded
    g. other (specify)

4. **Frequency of Home Visits:** Check the one that best describes the current visiting schedule.

5. **Graduation Date:** Put the date in numbers (month,day, year) of the child's graduation from the parent infant program.

Step 2

Explain parent notebook to parents (see pages 89–157). Have parents post parent notebook checklists in an obvious place and check highest level of child's behavior for preceding week. When particular checklist is completed, have parents put it back in the Parent Notebook.

Step 3

Obtain child and parent progress data and record on the SKI*HI Data Sheet during or after each home visit. It is suggested that the parent advisor take one SKI*HI Data Sheet (which becomes the parent advisor's master copy for that child) and then insert a carbon and another data sheet underneath the master for weekly submission to the supervisor. Or the parent advisor may xerox the master data sheet for the supervisor. The parent advisor retains the master copy for continued data entry.

Before recording child and parent data, the parent advisor should enter the home visit date in numbers (month/day/year) and the home visit number (1, 2, 3, 4 ... etc.). For example, the first home visit made to a home on Nov. 3, 1985 reads: Visit 1 on 11/3/85. When beginning a new data sheet, the first home visit number entered will be the next higher number after the last entry on the previous sheet. If the parent advisor goes to the home and the family is not there, date the home visit *but do not write in a new home visit number.* Then write "no show" across the blank lines below.

Child Data.

On all child data, slash the item ☒ if no longer reporting the item. Leave the item blank if the child has not yet achieved a new skill. For example, if the child has not yet begun the Auditory Program, leave the auditory development item blank. Or if the child achieves an auditory level of 4 one week but *does not achieve a new auditory level the next week* leave the next week blank.

1. **Time Hearing Aid Worn:** Begin recording weekly after initiating the Home Hearing Aid Program. Using the SKI*HI Data Sheet Key, write down the number of the appropriate time interval (as determined from the parent's entry on the Hearing Aid Wearing Time Checklist from the Parent Notebook). If the child does not achieve a new time interval during a particular week (for example, the child stays at 1/4 - 1/2 of the time), leave the current week blank. When the child wears the aid all of his waking hours or the hearing aid time recommended by the audiologist, discontinue reporting by slashing item on data sheet.

2. **Auditory Development:** Begin recording weekly after the Auditory Program is initiated. Using the SKI*HI Data Sheet Key, write down the number of the *highest* auditory level the child achieves during the week (as determined from the parent's entry on the Auditory Development Checklist from the Parents Notebook). The parent advisor will want to discuss with the parents the parent's entry on the Auditory Development Checklist and then using the guide below, make a final decision as to the auditory level that should be checked on the SKI*HI Data Sheet.

Determining The Child's Auditory Achievement Level

For Auditory Skills 1, 3, 4, and 6, achievement of a particular level is determined by the child's responding, without auditory clues (see page 394), to three or more different sound stimuli at a 50% or higher consistency level during a series of meaningful presentations of each sound. For example, the child is on the "locating" level if he can localize half the time without clues to three or more sounds (e.g., knocking, his name being called, electrical appliance) during a series of meaningful presentations of each sound (e.g., Mother knocks five times on kitchen cabinet while she is cooking and child responds three times).

For Auditory Skills 8, 9, and 10, achievement of a particular level occurs when the child is making more than 50% of his auditory responses on that level. For example, if most of the child's responses are discriminations of vocal sounds, words, or phrases, the child is on auditory level 9. For achievement of vocal skills (auditory skills 2, 5, 7, and 11), the child should be making 50% or more of his vocalizations on that level. If the child does not acquire a new auditory level (auditory level for current week is the same as the preceeding week), leave blank.

3. **Communication-Language Development:** Begin recording after *Communication Program* is initiated.

(a) **Language level:** Using SKI*HI Data Key, write down the number of the highest language level the child achieves during the week (as determined from the parent's entry on the Communication-Language Checklist from the Parent Notebook). The parent advisor should discuss the parent checklist entry with the parents and verify it if possible. If the child does not acquire a new language level (level for current week is same as preceding week), leave blank.

(b) **Vocabulary count:** Using the Key, write down the number of the appropriate vocabulary interval (as determined from the parent's entry on the Communication-Language Checklist from the Parent Notebook). The parent advisor should discuss with parents their entry on the Communication-Language Checklist. Using the following guide, the parent advisor can make a final decision as to what new vocabulary words should be counted for entry on the SKI*HI Data Sheet.

What Constitutes A New Vocabulary Word

Count as a new word, a morpheme that is distinguishable as a word and has been used spontaneously (not imitatively) by the child more than once. If the word is so misarticulated that it is not recognizable as a word (child says ma or makes an unrecognizable or unrelated sign as he points to a doggie) do not count it as a morpheme (word). If the child understands one morpheme (cat) but uses it in an over-generalized manner to refer to any furry animal with four legs and a tail, only one morpheme will be counted (the verbalized or signed cat is very different from the word dog).

If the child says a morpheme /bä-bä/ for bottle and another morpheme /bä-bē/ for baby, the parents can "hear" the differences and will note the presence of two morphemes. Similarly, if the child signs a close approximation for father and a slightly different but distinguishable approximation for boy, the parent will note the presence of two morphemes. If the child utters one morpheme /bä-bä/ in many different situations, such as when the child wants his /bä-bä/ (bottle), waving and saying /bä-bä/ (bye-bye) or pointing to a /bä-bä/ (baby), the parent will know the child has *three* morphemes if:

1. There is a close approximation of the uttered word to the real word (/bä-bä/ to bye-bye or /bä-bä/ to baby) *and,*
2. If there is a strong indication of the child's knowing the three words because of (a) gestural clues such as waving and saying /bä-bä/ or pointing or reaching for a /bä-bä/ (bottle) or (b) environmental clues (whenever mother gives the child a bottle the child says /bä-bä/ or whenever the child sees a baby the child says /bä-bä/).

This principle can also be applied when the child is using signs. For example, the child may use the same squeezing or wrist-twisting motion for milk, orange, and ice cream, but indications may be that he knows and distinguishes the three different words.

If the child utters /bä-bä/ or makes one sign indiscriminately as a generalized response to many events or objects (points to many things and makes the sign or says /bä-bä/) only one morpheme will be counted. If the child uses two words together such as /allgone/ or /allwet/ that represent one meaningful unit, only one morpheme will be counted.

If during a particular week the child does not achieve a new vocabulary count interval (for example, child stays at 21-30 words), leave the space for that week blank. When the child has more than 300 words, discontinue recording by slashing item on the data sheet.

Parent Data.

On all parent data, slash the item ⧄ if no longer reporting the item. Leave the item blank if the parent has not achieved new skills. For example, if the Language Program has not been initiated, leave the new language skills item blank. Or if the parent achieves language skills 1 and 2 during a preceding week and no new skills for the current week, leave the current week blank.

1. **Hearing Aid Skills:** Begin recording after initiation of the Home Hearing Aid Program. Write down *only once,* the *number of the home visit* during which the parent receives 80-100% on the hearing aid competency test. The competency test is in hearing aid lesson 9 and is on pages 231–234. For example, if the parent achieves 80-100% on the competency test during visit 10, write down 10. Discontinue reporting by slashing this item after the parent achieves 80-100% on the competency test.

2. **New Auditory Skills:** Begin recording after initiation of the Home Auditory Program. Using the SKI*HI Data Sheet Key, write down the number(s) of all new skills the parent acquired during the home visit or preceding week. (See page 71 for complete description of determining parent progress.) If the parent achieves *no* new auditory skills during a particular week (for example, the parent achieves auditory skills 3 and 4 during a preceding week but achieves no new skills during the current week), leave the space for the current week blank.

3. **New Communication Skills:** Begin recording after initiation of the Home Communication Program. Using the Key, write down the number(s) of all new skills the parent acquires during the home visit or preceding week. (See page 71 for complete description of determining parent progress.) If the parent achieves *no* new communication skills during a particular week (for example, the parent achieves communication skill 3 and 4 during a preceding week but achieves no new skills during the current week), leave the space for the current week blank.

4. **New Language Stimulation Skills: Aural-Oral:** Begin recording after initiation of the Language Stimulation Program: Aural-Oral. Using the Key, write down the number(s) of all new skills the parent acquires during the home visit or preceding week. (See page 71 for complete description of determining parent progress.) If the parent achieves *no* new language skills during a particular week (for example, the parent achieves language skills 2 and 3 during a preceding week but achieves no new skills during the current week), leave the space for the current week blank. Leave blank if the family is using Language Stimulation Program: Total Communication.

5. **New Language Stimulation Skills: Total Communication:** Begin recording after initiation of the Language Stimulation Program: Total Communication. Using the Key, write down the number(s) of all new skills the parent acquires during the home visit or preceding week. (See page 71 for complete description of determining parent progress.) If the parent achieves *no* new total communication skills during a particular week (for example, the parent achieves total communication skills 7 and 8 during a preceding week but achieves no new skills during the current week), leave the space for the current week blank. Leave blank if the family is using Language Stimulation Program: Aural-Oral.

6. **New Cognition Skills (optional):** Begin recording after initiation of the Home Cognition Program. Using the Key, write down the number(s) of all new skills the parent acquires during the home visit or preceding week. (See page 71 for complete description of determining parent progress.) If the parent achieves *no* new cognition skills during a particular week (for example, the parent achieves cognition skills 1 and 2 during a preceding week but achieves no new skills during the current week), leave the space for the current week blank.

Step 4

Submit the carbon or xerox copy of the SKI*HI Data Sheet weekly to the supervisor. It is possible that the copy sent to the supervisor will also contain the Lesson Plan and Lesson Narrative Report if *suggestion 1* on page 62 is being used. If *suggestion 2* is being used, the parent advisor may be required to send to the supervisor both the Lesson Plan and Lesson Narrative Report (one form) and the SKI*HI Data Sheet (another form). In some programs, submission of the Lesson Plan and Narrative Report Form may not be required or may eventually be phased out if the parent advisor and supervisor deem it appropriate. However, it is suggested that the parent advisor continue to make written lesson plans and narrative reports for her own use even if she is not submitting them to her supervisor.

Upon receipt of the carbon copies, the supervisor reviews parent and child progress, responds to any parent advisor comments, and files the report chronologically in the child's file.

Step 5

Administer LDS to child *at time of entry into the program* and twice yearly. Record date and results on SKI*HI Data Sheet. Administer and report on other tests as appropriate.

Language Development Scale (LDS): Parent advisor records LDS test scores and dates whenever the LDS is given. Children in SKI*HI replication sites should receive the test at least twice a year. More frequent administrations are encouraged. *The first administration of the LDS must take place within the first three months of the child's enrollment in the program.* This first administration constitutes the pretest. The earlier the first administration can be given, the greater the likelihood of demonstrating child progress.

Parent advisor should record the child's receptive and expressive ages (RA and EA). These ages will be the *highest age* in months of the highest interval achieved (for example, if the child's receptive age interval is 20- 22 months, the RA would be recorded as 22 months). Parent advisors should make sure to date all test administrations in numbers: month/day/year.

Other tests: Administrations of tests (other than the LDS) are optional. All test administrations must be dated. If the SKI*HI Receptive Language Test is given, enter the child's percentage scores for Parts A, B, C, and D. If the child does not respond, enter a *0*.

Step 6

By May 31 of each year, SKI*HI Data Sheets (on every child in the local program) should be submitted to the SKI*HI Institute Data Manager.

Notices will come from the SKI*HI Data Bank Manager (SKI*HI Institute) to remind replication site personnel to submit copies of their SKI*HI Data Sheets in *May*. The program should *cut off the child's name at the top of the SKI*HI Data Sheet to ensure anonymity of the data,* make copies of all data sheets kept on each child since the previous May's submission, and send the copies to:

SKI*HI Data Manager
SKI*HI Institute
Department of Communicative Disorders
Utah State University
Logan, Utah 84322-9605
(801) 752-4601

In small programs that do not have a supervisor, the parent advisor will need to follow the above procedures to submit data on her children.

At the SKI*HI Data Center, all data will be analyzed. Reports will be sent to replication site personnel describing the progress of parents and children in the entire SKI*HI Network and in their particular site if more than 10 children are served. In order to help replication site personnel interpret and use these reports, the section below is given.

Data Collection and Submission Quick Reference

Step 1

Complete demographic Section I of SKI*HI Data Sheet at program initiation. Complete Demographic Section II at program initiation and thereafter when additions/changes are made.

Step 2

Explain parent notebook to parents (see pages 89–157). Have parents put parent notebook checklists in an obvious place (ex: refrigerator door) and check highest level of child's behavior for preceding week. When particular checklist is completed, have parents put it back in the Parent Notebook.

Step 3

Obtain child progress data (from parent checklists and parent advisor observation) and record highest level of child's behavior on Master SKI*HI Data Sheet during each home visit. Record parent progress data. A carbon and another data sheet may be inserted underneath the master data sheet for submission to supervisor (or a xerox copy may be submitted).

Step 4

Submit copy of SKI*HI Data Sheet weekly to supervisor (and as appropriate, Lesson Plan and Lesson Narrative Report).

Step 5

Administer Language Development Scale (LDS) to child at least twice yearly and record date and results on SKI*HI Data Sheet. Administer and report on other tests as appropriate.

Step 6

By May 31, all data sheets should be submitted to the SKI*HI Institute Data Manager.

Appendix C

CODER________ DATE______ CODING CKD BY__________
ENTERED BY_____ DATE______ ENTRY CKD BY___________

SKI*HI DATA CODING INSTRUMENT

TO BE USED WITH DATA FROM 1986 TO PRESENT.

	VARIABLES	**COLUMNS**	
1.	SITEID	1-4	__ __ __ b
2.	RECORDN	5	1
3.	CHILDID	6-9	b __ __ __
4.	BMN	10-12	__ __ b
5.	BDA	13-15	__ __ b
6.	BYR	16-19	__ __ b b
7.	SEX	20-21	b __
8.	PROM	22-24	__ __ b
9.	PRODA	25-27	__ __ b
10.	PROYR	28-31	__ __ b b
11.	AGEID	32-34	__ __ __
12.	OTHERH	35-36	b __
13.	AGEHAFT	37-39	__ __ __
14.	OTFAM	40-41	b __
15.	RELAT	42-45	b b b b
16.	MNTHS	46-48	__ __ __
17.	SFU	49-52	b __ __ __
18.	SFUDATE	53-62	__ __ b b __ __ b b
19.	GRADM	63-65	__ __ b
20.	GRADYR	66-67	__ __
21.	ADAPT	68-69	b __

<hard return>

	VARIABLES	**COLUMNS**	
22.	SITEID	1-4	__ __ __ b
23.	RECORDN	5	2
24.	CHILDID	6-9	b __ __ __
25.	SFA	10-13	b __ __ __
26.	SFADATE	14-23	__ __ b b __ __ b b
27.	DXTORX	24-25	__ __

###################################

28.	RACE	42-43	b __
29.	OTHER	44-45	b __
30.	LANG	46-47	b __
31.	FREQ	48-50	b __ b
32.	FREQCHG	51	__
33.	TYPEHL	52-53	b __
34.	CAUSEHL	54-56	b __ __
35.	DATEOC	57-66	__ __ b b __ __ b b
36.	COMMCHG	67-68	b __
37.	COMM	69-70	b __
38.	COMDATE	71-78	__ __ b __ __ b __ __
39.	YR	79-80	b 2

<hard return>

TEST DATA-POSTTEST

1.	SITEID	1-4	__ __ __ b
2.	CHILDID	5-8	b __ __ __
3.	TESTID	9-12	b b __ __
4.	LDSO1	32-41	__ __ b b __ __ b b
5.	LDSO2	42-44	__ __ __
6.	LDSO3	45-47	__ __ __

<hard return>

TEST DATA-POSTTEST

1.	SITEID	1-4	__ __ __ b
2.	CHILDID	5-8	b __ __ __
3.	TESTID	9-12	b b __ __
4.	LDSO1	32-41	__ __ b b __ __ b b
5.	LDSO2	42-44	__ __ __
6.	LDSO3	45-47	__ __ __

<hard return>

CODED BY ______________________________
CHECKED BY ____________________________

VARIABLES	**COLUMNS**	
40. SITEID	1-4	___ ___ ___ b
41. RECORDN	5	3
42. CHILDID	6-9	b ___ ___ ___
43. S#8889	10-12	b ___ ___
44. S#8990	13-14	___ ___
45. S#9091	15-16	___ ___
46. S#8788	17-18	___ ___
47. BEGTHAW	19	___
48. THAW	20	___
49. THMODAYR	21-26	___ ___ ___ ___ ___ ___
50. MODAYRTH	27-32	___ ___ ___ ___ ___ ___
51. ADL	33-35	b ___ ___
52. BEGADL	36-37	___ ___
53. ADMODAYR	38-41	___ ___ ___ ___
54. MODAYRAD	42-47	b b ___ ___ ___ ___
55. CLDL	48-50	b ___ ___
56. BEGCLDL	51-52	___ ___
57. CLMODAYR	53-56	___ ___ ___ ___
58. MODAYRCL	57-62	b b ___ ___ ___ ___
59. BEGVI	63	___
60. VI	64	___
61. VIMODAYR	65-70	___ ___ ___ ___ ___ ___
62. MODAYRVI	71-76	___ ___ ___ ___ ___ ___
63. VISIT#	77-78	___ ___
64. AS#	79-80	___ ___

<Hard Return>

VARIABLES	**COLUMNS**	
65. SITEID	1-4	___ ___ ___ b
66. RECORDN	5	4
67. CHILDID	6-9	b ___ ___ ___
68. ASMODAYR	10-15	___ ___ ___ ___ ___ ___
69. MODAYRAS	16-21	___ ___ ___ ___ ___ ___
70. CS#	22-24	b ___ ___
71. CSMODAYR	25-30	___ ___ ___ ___ ___ ___
72. MODAYRCS	31-36	___ ___ ___ ___ ___ ___
73. AO#	37-38	b ___
74. AOMODAYR	39-44	___ ___ ___ ___ ___ ___
75. MODAYRAO	45-50	___ ___ ___ ___ ___ ___
76. TC#	51-53	b ___ ___
77. TCMODAYR	54-59	___ ___ ___ ___ ___ ___
78. MODAYRTC	60-65	___ ___ ___ ___ ___ ___
79. CG#	66-68	b ___ ___
80. CGMODAYR	69-74	___ ___ ___ ___ ___ ___
81. MODAYRCG	75-80	___ ___ ___ ___ ___ ___

<Hard Return>

Appendix D

SKI*HI DATA CODING CONVENTIONS

Revised 2/14/90

To be used for data from 1986 to present. Note: Use zero fill.

1.	SITEID	3-character label in spaces 1,2,3. Blank in space 4.
2.	RECORDN	A 1 should appear in column 5.
3.	CHILDID	Blank in 6. 3-digit ID# in 7,8,9.
4.	BMN	Month of Birth. 2 digits in 10 & 11. Blank in 12.
5.	BDA	Day of Birth. 2 digits in 13 & 14. Blank in 15.
6.	BYR	Year of Birth. 2 digits in 16 & 17. Blanks in 18 & 19.
7.	SEX	Blank in 20. 1 digit in 21. 1= male 2= female
8.	PROM	Program start month. 2 digits in 22 & 23. Blank in 24.
9.	PRODA	Program start day. 2 digits in 25 & 26. Blank in 27.
10.	PROYR	Program start year. 2 digits in 28 & 29. Blanks in 30 & 31.
11.	AGEID	Age of identification in months. Calculate. Zero fill in 32. 2 digits in 33 & 34. To calculate age in months, use the following guidelines: One month= 30 days. If child's days are greater than 15, add one to the month column. If days are less than or equal to 15, leave month column as is.

Example:	Year	Month	Day
		15	
	87	3	33
If Date of ID equals	88	4	3
and Date of Birth equals	86	6	9
Subtract to get ID Age:	1	9	24
Since days are >15 add 1 to months:	1	10	
Multiply yrs x 12 & add to months:	(1 x 12) + 10= 22 months		

If days not specified on Date of ID, then calculate AGEID using Date of Birth (rounded up one months if days greater than 15).

12.	OTHERH	Other handicaps. If no response is provided by site, assume the answer is No, except in those instances where the entire demographic section is left blank. Blank in 35. 1 digit in 36. 1= yes, 2= no.
13.	AGEHAFT	Age of hearing aid fit in months. Calculate Zero fill in 37. 2 digits in 38 & 39. Subtract Date of Birth from date Hearing Aid Fit.
14.	OTFAM	Other Family Member with Hearing Problem. Blank in 40. 1 digit in 41. 1= yes, 2= no.
15.	RELAT	Dropped from new data sheet. Blanks in 42, 43, 44, and 45.
16.	MNTHS	Months between suspicion of loss and identification of loss. Calculate. Zero fill in 46. 2 digits in 47 & 48.
17.	SFU	Hearing loss, unaided, in dB values. Use best ear dB, if give both ears. If No Response to sound is indicated, then enter 120 dB. Also, use the following guidelines: 0 - 20 = normal hearing; 25 - 40 = mild loss; 45 - 60 = moderate loss; 65 - 90 = severe loss; 90+ = profound loss. Enter a decibel value in the middle of each range. Blank in 49. Zero fill in 50, if needed. Digits in 51 & 52.
18.	SFUDATE	Date of unaided test. Month in 53 & 54. Blank in 55. Day in 56 & 57. Blank in 58. Year in 59 & 60. Blanks in 61 & 62.
19.	GRADM	Month of graduation in 63 and 64. Blank in 65.
20.	GRADYR	Year of graduation in 66 and 67.
21.	ADAPT	Was program adapted for the child? Any data sheet with stars around the outside indicates program was adapted. Blank in 68. One digit in 69. 1= yes 2= no
22.	SITEID	3-character label in spaces 1,2,3. Blank in space 4.
23.	RECORDN	A 2 should appear in column 5.
24.	CHILDID	Blank in 6. 3-Digit ID# in 7, 8, 9.

25.	SFA	Hearing loss, aided in dB values. Blank in 10. Zero fill in 11, if needed. Digits in 12 & 13. Use best ear dB if give both ears.
26.	SFADATE	Date of aided test. Month in 14 & 15. Blank in 16. Day in 17 & 18. Blank in 19. Year in 20 & 21. Blanks in 22 & 23.
27.	DXTORX	Time span between Diagnostic/Prescription date and first communication Methodology choice. 2 digits in 24 & 25.
28.	RACE	Race/National origin. Blank in 42. One digit in 43. 1= Caucasian 2= Black 3= Others 4= Oriental American 5= Spanish American 6= American Indian
29.	OTHER	Other non-Parent-Infant Program Services. Blank in 44. One digit in 45. 1= Educational 2= Mental Health 3= Health 4= Social 5= Mental Retardation 6= Other (Combination Services) 7= Speech & Hearing Rx 8= Educational + Speech & Hearing Rx
30.	LANG	Primary language spoken in the home. Blank in 46. One digit in 47. 1= English 2= ASL 3= Spanish 4= Other 5= Signed English System
31.	FREQ	Frequency of home visits. Blank in 48. One digit in 49. Blank in 50. 1= Irregular 2= Once a week (3 x/mo. also coded as 2) 3= Every other week 4= Monthly 5= Bi-monthly 6= Twice a week 7= Other

32.	FREQCHG	Did frequency of home visits change? One digit in 51. Yes= 1 No= 2
33.	TYPEHL	Type of Hearing Loss. Blank in 52. Digit in 53. 1= Not yet determined. 2= Conductive 3= Sensorineural 4= Mixed
34.	CAUSEHL	Cause of hearing loss. Blank in 54. Digits in 55 and 56. 1= Unknown 2= Hereditary 3= Maternal Rubella, CMV or other infections during pregnancy 4= Meningitis 5= Defects at birth (Atresia) 6= Fever or infections in child 7= RH incompatibility/Kernicterus/Jaundice 8= Drugs during pregnancy 9= Other conditions during pregnancy (premature) 10= Middle ear problems or ENT anomalies (Otitis Media) 11= Drugs administered to child 12= Birth trauma 13= Child syndrome 14= Other (specify) 15= Not Reported
35.	DATEOC	Date of occurrence of hearing loss, if after birth. Month in 57 & 58. Blank in 59. Day in 60 & 61. Blank in 62. Year in 63 & 64. Blanks in 65 & 66.
36.	COMMCHG	Did communication method change from aural to total or from total to aural or to other, etc.? (Note: Do not mark a "Yes" if Communication Methodology has gone from Diag./Prescriptive to Aural or to Total--this does not indicate a change in Communication Methodology.) Blank in 67. One digit in 68. If still in diagnostic/prescriptive phase, leave blank. 1= yes 2= no

37.	COMM	Present Communication Method. Blank in 69. Digit in 70. 1= Diagnostic-prescriptive 2= Auditory (Aural-Oral) 3= Total Communication 4= Other
38.	COMDATE	Date family begins to use present Communication Method. Month in 71 & 72. Blank in 73. Day in 74 & 75. Blank in 76. Year in 77 & 78.
39.	YR	Blank in 79. A 2 should appear in 80.
40.	SITEID	3-character label in spaces 1,2,3. Blank in space 4.
41.	RECORDN	A 3 should appear in column 5.
42.	CHILDID	Blank in 6. 3-Digit ID# in 7, 8, 9.
43.	S#8889	Blank in 10. Actual number of sessions child received from pretest to posttest for 1988-89 year. 2 digits in 11 & 12.
44.	S#8990	Actual number of sessions child received from pretest to posttest for 1989-90 year. 2 digits in 13 & 14.
45.	S#9091	Actual number of sessions child received from pretest to posttest for 1990-91 year. 2 digits in 15 & 16.
46.	S#8788	Actual number of sessions child received from pretest to posttest for 1987-88 year. 2 digits in 17 & 18.
47.	BEGTHAW	Put number representing beginning amount of time hearing aid was worn. 1 digit in 19.
48.	THAW	Put number representing largest amount of time hearing aid is worn by child in 20.
49.	THMODAYR	Month, Day and Year of first entry for Time Hearing Aid Worn. Month in 21 & 22, Day in 23 & 24, and Year in 25 & 26.
50.	MODAYRTH	Month, Day and Year of entry for largest amount of time hearing aid is worn by child. Month in 27 & 28, Day in 29 & 30, and Year in 31 & 32.
51.	ADL	Put highest auditory development level attained by child in 34 & 35. Blank in 33.
52.	BEGADL	Beginning auditory level in 36 and 37.

53.	ADMODAYR	Month and Year of first entry for Auditory Development. If days greater than 15, round month up one. Month in 38 & 39, Year in 40 & 41.
54.	MODAYRAD	Month and Year of entry for highest auditory development level. Blanks in 42 & 43, Month in 44 & 45, Year in 46 & 47. If days greater than 15, round month up one.
55.	CLDL	Blank in 48. Put highest communication-language-development level attained by child in 49 & 50.
56.	BEGCLDL	Put beginning Communication-Language-Development Level of child in 51 and 52.
57.	CLMODAYR	Month and Year of first entry for Communication-Language Development. Month in 53 & 54, Year in 55 & 56.
58.	MODAYRCL	Month and Year of entry for highest communication-language development level. Blanks in 57 & 58, Month in 59 & 60, Year in 61 & 62.
59.	BEGVI	Put beginning Vocabulary Interval in 63.
60.	VI	Put number representing highest vocabulary interval attained by child in 64.
61.	VIMODAYR	Month, Day and Year of first entry for Vocabulary Interval. Month in 65 & 66, Day in 67 & 68, Year in 69 & 70.
62.	MODAYRVI	Month, Day and Year of entry for highest Vocabulary Interval. Month in 71 & 72, Day in 73 & 74, Year in 75 & 76.
63.	VISIT#	Visit number the parent achieves 80-100% on hearing aid competency test. 2 digits in 77 & 78.
64.	AS#	Put number of auditory skills attained by parent in 79 & 80.
65.	SITEID	3-character label in spaces 1,2,3. Blank in space 4.
66.	RECORDN	A 4 should appear in column 5.
67.	CHILDID	Blank in 6. 3-Digit ID# in 7, 8, 9.
68.	ASMODAYR	Month, Day and Year of first entry for Auditory Skill Program. Month in 10 & 11, Day in 12 & 13, Year in 14 & 15.

69.	MODAYRAS	Month, Day and Year of last entry for a new Auditory Skill attained. Month in 16 & 17, Day in 18 & 19, Year in 20 & 21.
70.	CS#	Blank in 22. Put number of communication skills attained by parent in 23 & 24.
71.	CSMODAYR	Month, Day and Year of first entry for Communication Skills Program. Month in 25 & 26, Day in 27 & 28, Year in 29 & 30.
72.	MODAYRCS	Month, Day and Year of last entry for new Communication Skill attained. Month in 31 & 32, Day in 33 & 34, Year in 35 & 36.
73.	AO#	Blank in 37. Put number of Aural-Oral skills attained by parent in 38.
74.	AOMODAYR	Month, Day and Year of first entry for Aural-Oral Skills Program. Month in 39 & 40, Day in 41 & 42, Year in 43 & 44.
75.	MODAYRAO	Month, Day and Year of last entry for new Aural-Oral Skill attained. Month in 45 & 46, Day in 47 & 48, Year in 49 & 50.
76.	TC#	Blank in 51. Put number of total communication skills attained by parent in 52 & 53.
77.	TCMODAYR	Month, Day and Year of first entry for Total Communication Program. Month in 54 & 55, Day in 56 & 57, Year in 58 & 59.
78.	MODAYRTC	Month, Day and Year of last entry for new Total Communication Skill attained. Month in 60 & 61, Day in 62 & 63, Year in 64 & 65.
79.	CG#	Blank in 66. Put number of cognition skills attained by parent in 67 & 68.
80.	CGMODAYR	Month, Day and Year of first entry for Cognition Skills Program. Month in 69 & 70, Day in 71 & 72, Year in 73 & 74.
81.	MODAYRCG	Month, Day and Year of last entry for new Cognition Skill attained. Month in 75 & 76, Day in 77 & 78, Year in 79 & 80.

TEST DATA-PRETEST

1.	SITEID	3-character label in space 1, 2, 3. Blank in 4.
2.	CHILDID	Blank in 5. 3-digit-ID# in 6, 7, 8.

3.	TESTID	Blanks in 9 & 10. 2-digit code in 11 & 12. 15= 1986-87 Pretest 16= 1986-87 Posttest 17= 1987-88 Pretest 18= 1987-88 Postest 20= 1988-89 Pretest 21= 1988-89 Postest 22= 1989-90 Pretest 23= 1989-90 Postest 24= 1990-91 Pretest 25= 1990-91 Postest 26= 1991-92 Pretest 27= 1991-92 Postest
4.	LDSO1	Date of administration of LDS. Month in 32 & 33. Blank in 34. Day in 35 & 36. Blank in 37. Year in 38 & 39. Blanks in 40 & 41.
5.	LDSO2	Receptive Age on LDS. Zero fill 42. 2-digit score in 43 & 44.
6.	LDSO3	Expressive Age on LDS. Zero fill 45. 2-digit score in 46 & 47.

TEST DATA-POSTTEST

1.	SITEID	3-character label in 1, 2, 3. Blank in 4.
2.	CHILDID	Blank in 5. 3-digit-ID# in 6,7,8.
3.	TESTID	Blanks in 9 & 10. 2-digit code in 11 & 12. 15= 1986-87 Pretest 16= 1986-87 Postest 17= 1987-88 Pretest 18= 1987-88 Postest 20= 1988-89 Pretest 21= 1988-89 Postest 22= 1989-90 Pretest 23= 1989-90 Postest 24= 1990-91 Pretest 25= 1990-91 Postest 26= 1991-92 Pretest 27= 1991-92 Postest
4.	LDSO1	Date of administration of LDS. Month in 32 & 33. Blank in 34. Day in 35 & 36. Blank in 37. Year in 38 & 39. Blanks in 40 & 41.
5.	LDSO2	Receptive Age on LDS. Zero fill 42. 2-digit score in 43 & 44.
6.	LDSO3	Expressive Age on LDS. Zero fill 45. 2-digit score in 46 & 47.

SKI*HI INSTITUTE: REAP QUESTIONNAIRE SITE PREFIX: __ __ __ CHILD ID#: __ __ __

QUESTION 1: To determine how children receiving home programming were first identified as possibly having a hearing impairment, we will need the following information for each of the hearing impaired children served by your site during 1988-1990, as identified by the CHILD ID# at the top of each questionnaire.

A. Was this child born in a hospital in which a high-risk register is completed for each child.
Circle one: Yes / No / Unknown

B. Did this child spend time in a NICU after birth? Circle one: Yes / No / Unknown

C. Did a formal, infant hearing-screening program provide the first indication that the child possibly had a hearing impairment? Circle one: Yes / No / Unknown

D. If yes (i.e., a formal, infant hearing-screening program provided the first indication that the child possibly had a hearing impairment), please specify which of the following screening procedures was used.
Circle one:
1) Crib-O-Gram
2) Otoacoustic Emission Screening
3) Middle Ear (Immittance/Impedance) Screening
4) Behavioral Audiometry--Screening
5) ABR Screening
6) Other--Please Specify________________________________

E. If the child participated in a formal, infant hearing-screening program, was the child referred to the parent-infant program by the screening agency? Circle one: Yes/No
What was the referring source or type of agency? ________________________________

F. If no (i.e., a formal, infant hearing-screening program did not provide the first indication that the child had a hearing impairment), please specify who referred the child for audiological testing and what caused the individual to suspect that the child had a hearing impairment. Circle one:
1) Parental Suspicion and Referral
   What caused the suspicion?________________________
2) Suspicion and Referral (by someone other than parent)
   Who Suspected?________________________________
   What caused the suspicion?________________________
3) Other--Please Specify________________________________

QUESTION 2: To determine where children were placed after receiving services through your parent-infant program, we will need the following information for each of the hearing impaired children who have been served by your site, but who have "graduated" from your program.

A. Immediately after graduation from your program, this child was placed in: (Circle one)
1) Self-contained classroom for hearing impaired children
2) Mainstreamed/integrated classroom
3) Residential Program
4) Day School for Hearing Impaired Children
5) Transition Program--Please Specify________________________
6) Home Care/Day Care
7) Head Start/Home Start
8) In Home--No Services
9) Individual Service--Indicate one of following:
   a) Clinician Services in Home
   b) Center-based Therapy
   c) Other--Please Specify________________________
10) Combination of Services--Please Specify____________________
11) Other--Please Specify________________________________

B. What is this child's current placement. Please specify________________________

DIRECTIONS FOR COMPLETING QUESTIONNAIRE

PURPOSE: The purpose of question 1 is to determine which method of infant hearing screening was used (if any) that first alerted parents or professionals that a child had a possible hearing impairment. Screening does not include diagnostic testing completed after suspicion of hearing loss. Screening usually takes place during the first few months of life and is designed to refer an infant for further diagnostic testing. Therefore, as you answer question 1, keep in mind we are looking for screening method only, not diagnostic testing. You may need to telephone parents if you cannot determine the answers to Question 1 from the information available to you in the files.

QUESTION: 1A. If your state has a high risk register and the child was born in a hospital in your state you may assume that the child was included in the high risk register whether or not that information is in the child's file. If you don't know the answer to this question, circle unknown.

1B. If information is in the child's file or you can determine the response in some other way, then circle the appropriate answer. If you are unable to determine the answer, circle unknown.

1C. Refers to formal, infant screening programs other than the high-risk registry. If the child was was identified through a formal, infant screening program, answer yes. If you have information indicating that parental suspicion was used to screen for hearing impairment, then circle no and skip to Question 1F.

1D. Circle the answer that applies. If none of the choices apply, but some other method of screening was used, describe in #6. Remember, this question refers to screening method only, not to diagnostic testing that may have been performed after the screening to confirm a hearing loss.

1E. Answer from the information available to you.

1F. Answer from the information available to you.

PURPOSE: The purpose of question 2 is to determine where children were placed after "Graduating" from a parent-infant program.

QUESTION: 2A. Please answer from the available information or contact the parent.

2B. Specify the child's current placement-use choices listed in 2A or write in a placement that is not listed in 2A.

Appendix F

QUESTIONNAIRE DATA CODING CONVENTIONS

1.	SITEID	3-character label in spaces 1,2,3. Blank in spaces 4 and 5.
2.	CHILDID	3-digit ID# in 6,7,8. Blank in 9.
3.	HIGHRISK	Child born in hospital with high-risk register? 1=YES; 2=NO; 3=UNKNOWN; 4=NO RESPONSE in column 10. Blank in 11.
4.	NICU	Child spend time in NICU? 1=YES; 2=NO; 3=UNKNOWN; 4=NO RESPONSE in column 12. Blank in 13.
5.	PROGID	Child participate in formal, infant hearing screening program? 1=YES; 2=NO; 3=UNKNOWN; 4=NO RESPONSE in column 14. Blank in 15.
6.	IDTYPE	Type of hearing screening program in columns 16 and 17. Blank in 18. 1=Crib-O-Gram 2=Otoacoustic Emission Screening 3=Middle ear (immittance/impedance) 4=Behavioral Audiometry--screening 5=ABR screening 6=Other 7=Combination 3, 4, 5 34=Combination 3 and 4 35=Combination 3 and 5 45=Combination 4 and 5
7.	REFER	Child referred by screening agency? 1=YES; 2=NO; 4=NO RESPONSE in column 19. Blank in 20.

8. REFTYPE

Who was referring source or type of agency in columns 21-22. Blank in 23.
1=Hearing and speech clinic
2=Audiologist
3=Health Department
4=Neighbor
5=Hospital
6=Pediatrician
7=Medical
8=Central Institute for Deaf (CID)
9=Boys Town
10=Preschool/Developmental Program
11=Parents as Teachers
12=Parents
13=Physician
14=Handicapped Services/Exceptional Child Program
15=Public or Private School
16=ENT
17=School for the Deaf and Blind
18=Social Worker/Human Services/Adoption Agency
20=Parent Advisor
21=Callier
22=Keep Pace Program
27=High-Risk Registry
28=HEAR Foundation

9. IDWHO

Who suspected in 24-25. Blank in 26.
00=No Response
1=Parent
2=ENT
3=Grandparent
4=Day Care Center
5=Pediatrician
6=Physician
7=Foster Parent
8=Baby Sitter
9=Child Development Specialist/Center for Developmental Disabilities
10=Unknown (e.g., adopted)
11=Parents as Teachers Organization
12=Head Start
13=Relatives
14=Medical Staff
15=School for the Blind
16=Audiologist
17=Psychologist
18=Friend/Neighbor
19=Speech Therapist
20=Parent Adviser
21=School Personnel (pre or elem.)
22=Other
23=Health Department/Human Services

10. IDWHAT

What caused the suspicion in 27-28.
Blanks in 29-30.
0=Unknown
1=Low/No Response to Auditory Stimulus
2=Delayed Language/Development
3=Otitis Media--Middle Ear
4=Heredity/Other Family Members H-I
5=Rubella/CMV
6=Meningitis
7=Syndrome
8=Premature
9=Birth Complications
10=No response to the question
11=Combination of 1, 2, and 3
12=Combination of 1 and 2
13=Combination of 1 and 3
14=Combination of 1 and 4
15=Combination of 1 and 5
16=Combination of 1 and 6
17=Combination of 1 and 7
20=Siezures
21=Decreased neck control/Hold Head to Side
22=Illness/High Temperature/Health Problems
23=Combination of 2 and 3
24=Combination of 2 and 4
26=Combination of 2 and 6
27=Combination of 2 and 7
30=Combination of 31 and 1
31=Birth Defect
32=Accident
33=Attention Deficit/Behavior Problem /Noisy Child
34=Combination of 3 and 4
35=Combination of 5 and 12
36=High-Risk Register Card
38=Combination of 7 and 31
40=Brain Damage
41=School Screening
42=Medical Check-up
43=Combination of 2 and 22
44=Combination 4 and 31
46=Combination 31 and 33
50=Doing poorly in school
51=Combination 4 and 36
52=Combination of 3 and 31
55=Combination of 2 and autistic behaviors
62=Combination of 2 and 33
63=Combination of 3 and 33
65=Combination of 2 and 31
69=Combination of 6 and 9
89=Combination of 8 and 9

11.	HICLASS	Self-contained classroom for the hearing impaired placement in 31. Blank in 32. 1=YES; 2=NO.
12.	MAINSTRM	Mainstreamed/integrated classroom placement in 33. Blank in 34. 1=YES; 2=NO.
13.	RESIDENT	Residential program placement in 35. Blank in 36. 1=YES; 2=NO.
14.	HIDAY	Day school for Hearing Impaired placement in 37. Blank in 38. 1=YES; 2=NO.
15.	TRANSIT	Transition program placement in 39. Blank in 40. 1=YES; 2=NO.
16.	TRANTYPE	Type of transition program in 41-42. Blank in 43. 1=Aid in the classroom 4=Itinerant Teacher 5=Callier
17.	DAYCARE	Home Care/Day Care placement in 44. Blank in 45. 1=YES; 2=NO.
18.	HEADSTRT	Head Start/Home Start Placement in 46. Blank in 47. 1=YES; 2=NO.
19.	NOSERVIC	In Home--No services placement in 48. Blank in 49. 1=YES; 2=NO.
20.	INDISERV	Individual services placement in 50. Blank in 51. 1=YES; 2=NO.
21.	INDITYPE	Type of individual services in 52-53. Blank in 54. 1=Clinician services in home 2=Center-based therapy 3=Speech and/or language therapy /Auditory Mgmt. 4=Combination of 1 and 2 5=Developmental School 6=Home-based 7=Private or Community preschool 17=Combination of 1 and 7 21=Combination of Center-based & Speech Therapy 86=Combination of 1, 6, and 7
22.	COMOTHER	Other combination of services in 55. 1=YES; 2=NO.

23.	COMTYPE	Type of combination of services in 56. Blank in 57. 1=Combination of 1 and preschool 2=Oral rehab, speech therapy, & developmental school 4=Services from Teacher of HI 5=P.T./O.T./Infant Stim
24.	OTHER	Other services placement in 58. Blank in 59. 1=YES; 2=NO.
25.	OTHTYPE	Type of other services in 60-61. Blank in 62. 00=Unknown 1=Classroom for Mentally Handicapped 2=Severely multiply impaired program/Down Syndrome Classroom 3=Another school district 4=Hasn't graduated 5=Non-categorical preschool class 6=Non-categorical preschool class & Head Start Combination 7=Non-categorical elementary classroom (include special education class and self-contained special ed. class) 8=Handicapped Services 9=Preschool with Speech Therapy 10=Self-contained classroom for deaf and blind 11=Classroom for autistic 15=Self-contained classroom for developmentally delayed (include day schools for developmentally delayed) 20=Day school 21=Public school 22=Preschool (Private or Public) 23=Developmental Disabilities/CHIPPS--1 day per week 24=Dropped out or discharged 26=Center-Based Program 30=Early intervention program 32=Preschool for Hearing Impaired 35=ECH for multi-handicapped 99=No Response--may have graduated but didn't tell placement.

26. CURPLACE

Child's current placement in 63-64.
0=Don't know/Moved/Placed in Another Program
1=No Response/Can't Tell: Abbreviation
2=Mainstreamed/integrated classroom
3=Residential program--School for Deaf
4=Day School for Hearing Impaired
5=Self-contained classroom for HI
6=Combination--Self-contained classroom plus Head Start/Early Childhood Class
7=Combination--self-contained plus preschool
8=In Home--No Services
10=Speech/Language Therapy
12=Combination--Self-contained classroom for HI and mainstreamed
13=Combination--Self-contained classroom plus mainstreamed with interpreter
14=Combination--Preschool plus interpreter plus Deaf Ed Classes
15=Special Ed with HI monitoring
17=Comb. Home-based with O.T./P.T. and Infant Stimulation
19=Combination--Self-contained classroom for HI and individual services
24=Combination of 2 and 4
27=Combination Preschool (Head Start) plus language therapy
28=Combination of Clinician Services, Home based, & private preschool
30=Speech Therapy
31=Private School plus cued speech plus language/speech therapy
45=Combination of 4 and 5
74=Preschool (public or private)
75=Combination Mainstream and Resource Room and/or Speech Therapy and/or Itinerant/Support Services
76=Preschool for Hearing Impaired
77=Preschool plus interpreter
78=Public School and Consultant
79=Transition program
80=Autistic classroom
81=School for the deaf and/or blind--Day School
82=Preschool/Early Childhood and Speech Therapy/Services from Teacher of HI
83=Handicapped Services
84=Noncategorical self-contained classroom
85=Combination--public school and special education
86=Combination--Individual services and center-based therapy
87=Special Ed. Class/Mental Retardation
88=Severely multiply impaired program
89=Combination--Self-contained classroom plus OT and PT

90=Combination--Mainstreamed and interpreter
91=Developmental Preschool/Day Care Center
92=Deceased
93=Public School
94=Preschool Noncategorical/Special Needs/Child Development Center
95=Hasn't graduated
96=Combination--Day School for HI and Center-based Therapy
97=Combination--Mainstreamed classroom and center-based therapy
98=Combination--Mainstreamed classroom and clinician services in home
99=Combination--Mainstreamed classroom, Home Care/Day Care, and center-based therapy

Appendix G
PERSONNEL DESCRIPTION
Utah Parent/Infant Program Parent Advisors--1990-1991
N = 35

Years of Professional Experience

Mean	10.6 years
Standard Deviation	6.7 years
Median	11 years
Mode	12 years
Range	1 to 33 years

Educational Credentials

Highest Degree	Area	Number of PAs
PhD	Developmental Psychology	1
MEd/MS/MA	Deaf Educ./Educ. of Hearing Impaired	6
	Speech-Language Pathology	5
	Audiology	4
	Family Relations	1
	Special Education	1
BS/BA	Elementary Education	4
	Communicative Disorders/Spch. & Hrg. Sc.	3
	Education	2
	Special Education	1
	Family Life	1
	Social Sciences	1
Associates	Liberal Arts	1
No Degree	Some College Course Work	4
	Total	35

Certification Credentials

Credential	Area	Number of PAs
Teaching	Elementary Education	9
	Special Education	8
	Deaf Educ/Teacher of Hearing Impaired	5
	Early Childhood	3
	Audiology	1
	Secondary Education	1
	Music Education	1
ASHA CCC	Speech-Language Pathology	2
	Audiology	2
Licensure	Utah: Speech-Language Pathology	1
SKI*HI	Trainer or National Trainer	3
Certificate	Sign Language	2
	Total	38

Note: Total certification credentials is greater than total number of PAs, because some PAs have multiple credentials while others have none.

Appendix H

SKI*HI DATA RESEARCH 1989-92
PARTICIPATION RESPONSE FORM

Name of Agency: ______________________________

Address: ______________________________

Site Prefix: ______________________________

Name of Contact Person for Data Research: ______________________________

Telephone Number: ______________________________

_____ Yes! We will participate in the SKI*HI Data Research Study that will investigate the relationship between specific identification procedures (e.g., Crib-o-gram, high-risk registers, parental suspicion and referral) and specific demographic variables (e.g., age of identification, time interval between suspicion of hearing loss and identification, and time between identification and program placement).

We understand our participation will involve the program supervisor's completion of a questionnaire concerning identification procedures. It will also involve facilitating a survey of parents who have participated in the program.

_____ Yes! We will participated in the SKI*HI Data Research Study that will investigate child placement information.

We understand this will involve the completion of a survey form.

Signed: ______________________________
(Signature)

____
(Typewritter or Printed Name)

____
(Position)

____
(Date)

SKI*HI INSTITUTE, Logan, Utah

Research on the Effectiveness of At-Home Programming (REAP)

Summary Data--SKI*HI National Data Bank--1979 to 1991

Utah and SKI*HI Overall

July, 1992

Skip Reese
Utah Parent-Infant-Program
Utah Schools for the Deaf and Blind
846 20th St.
Ogden, Utah 84401

Dear Skip:

In 1989 the U. S. Department of Education, Office of Special Education and Rehabilitative Services, awarded a research grant to the SKI*HI Institute for the purpose of analyzing the data submitted by parent advisors to the SKI*HI National Data Bank since 1979. That funding period ends on June 30, 1992. The three research objectives that have guided the investigation were to determine: (a) the demographic characteristics of the children with hearing impairments who have participated in home-based programming; (b) how the children with hearing impairments were identified and which identification procedure resulted in the earliest age of identification and program placement; and (c) the effectiveness of home-based programming with respect to child-communication gains, parent-skill acquisition, and placement after home-based programming. An in-depth final report will be submitted to the funding agency in July. The information will be disseminated as well through articles submitted to professional journals and through presentations at conferences.

Overall, data were submitted for 5,178 children between 1979 and 1991. During that same time period, data for 715 children (14% of the total) were submitted by the Utah Parent-Infant-Program.

Your site also participated in a special questionnaire study related to identification procedures and placement after home programming for the years 1986 to 1989. Overall, data were submitted for 1,404 children for that study, with your site contributing data for 211 children (15% of the total).

So that you can compare the findings for your site with those for SKI*HI overall, both sets of data are provided in the nine tables which are enclosed and appear in the following order:

Table

1 Frequencies and percentages of children for each of the demographic characteristics.

2 Mean, standard deviation, and median ages and intervals (in months). (Note: For this table, the median is a better estimate of central tendency than the mean.)

Table

3 Frequencies and percentages of children for identification procedure, who suspected the hearing loss, cause of suspicion of the hearing loss, referral by the screening agency, and type of referring agency.

4 Mean, standard deviation, and median pre-, post-, and predicted LDS scores and Proportional Change Indexes (PCIs) for both receptive and expressive language.

The pre-test scores are the first LDS receptive and expressive scores for each child that were submitted to the National Data Bank and the post-test scores are the last scores submitted. Treatment time is calculated by determining the time, in months, between the first and the last LDS test score.

The predicted mean post-test score indicates what the children would have scored as a result of maturation alone. For example, an actual mean post-test score of 26.5 and a predicted mean post-test score of 20.5 indicates that, on the average, the children's actual mean post-test score was six months greater than would be expected due to maturation alone.

The PCI is a ratio of the child's rate of progress during intervention as compared to the rate of progress prior to intervention. For example, a mean PCI of 2.0 indicates that the average rate of progress during intervention was two times greater than the average rate of progress prior to intervention.

5 Frequencies and percentages of children for each level of hearing aid usage and the average time (in months) to attain the children's highest level of hearing aid usage.

6 Mean, standard deviation, and median beginning and ending levels for child auditory, communication-language, and vocabulary development and acquisition times.

7 Mean, standard deviation, and median number of auditory, communication, aural-oral, total communication, and cognition skills acquired by parents and acquisition times.

8 Mean, standard deviation, median, and range for treatment density (i.e., actual number of visits per month) and treatment amount (i.e., time between the pretest and the posttest).

9 Frequencies and percentages of children for placement after home programming.

10 Frequencies and percentages of children for current placement.

If you need assistance in interpreting the tables, please contact Carol Strong or Beth Walden at the SKI*HI Institute by August 31, 1992 (801) 752-4601.

We have the following suggested uses for these data:

1. Make transparencies and/or copies of the tables.
2. Present the data to your parent advisors and other staff members. Your parent advisors will pleased to know the results of their work.
3. Share the data with your administrators, your state office, and, if possible to appropriate state professional groups. The data speak well of your program.

If you wish to use the data in written documents, please use the following citation as a reference:

Strong, C. J., Clark, T. C., Barringer, D. G., Walden, B., & Williams, S. A. (1992). Research on the effects of home intervention on hearing-impaired children and their families (Project No. H023C90117). Final Report to the U. S. Department of Education, Office of Special Education and Rehabilitative Services. Logan, UT: SKI*HI Institute, Department of Communicative Disorders, Utah State University.

Your participation in the National Data Bank has been greatly appreciated. We hope this summary of your contributions will be useful to you. And we hope that you will continue to submit demographic and child-progress data for the children that you serve.

Sincerely,

Dr. Carol Strong	Dr. Thomas C. Clark
Research Director, Project REAP	Project Director

Appendix J--Site Report Example

Table 1

Demographic Characteristics, 1979-1991

Variable	Utah N	Utah %	Overall N	Overall %
Gender				
Male	406	59	2772	55
Female	287	41	2276	45
Ethnicity				
Caucasian	604	89.0	3616	72.0
African American	8	1.2	726	14.4
Spanish American	22	3.2	470	9.4
Native American	23	3.4	109	2.2
Asian American	13	1.9	46	.9
Other	9	1.3	58	1.2
Language Spoken in Home				
English	650	95.0	4531	90.0
Spanish	7	1.0	243	4.8
ASL	6	.8	135	2.7
Signed English	3	.4	52	1.0
Other	18	2.6	76	1.5
Cause of Hearing Loss				
Unknown	257	35.9	2436	47.0
Meningitis	52	7.3	632	12.2
Heredity	88	12.3	517	10.0
Middle Ear Problems	92	12.9	253	4.9
Defects at Birth	41	5.7	246	4.8
Rubella/CMV	25	3.5	166	3.2
Birth Trauma	29	4.1	152	2.9
Child Syndrome	25	3.5	142	2.7
Conditions During Pregnancy	16	2.2	139	2.7
Fever or Infections in child	33	4.6	132	2.5
Drugs Given to Child	6	.8	45	.9
RH Incompatability or Kernicterus	3	.4	35	.7
Drugs During Pregnancy	4	.6	26	.5
Other	38	5.3	113	2.2
Not Reported	6	.8	144	2.8

Table 1 (Continued)

Variable	Utah		Overall	
	N	%	N	%
Planned Frequency of Home Visits				
Once a Week	629	93.3	4163	83.5
Every Other Week	30	4.5	455	9.1
Twice a Week	9	1.3	177	3.6
Monthly	3	.4	75	1.5
Irregular	3	.4	61	1.2
Bi-Monthly	--	--	11	.2
Other	--	--	42	.8
Actual Frequency of Home Visits				
One Time per Month	34	16.4	275	22.3
Two Times per Month	44	21.3	326	26.5
Three Times per Month	64	30.9	366	29.8
Four Times per Month	50	24.2	207	16.8
Greater than Four Times Per Month	15	7.2	55	4.5
Treatment Amount				
0 to 6 Months	67	13.0	466	14.4
6 to 12 Months	145	28.1	991	30.7
12 to 18 Months	118	22.9	720	22.3
18 to 24 Months	99	19.2	506	15.7
Greater than 24 Months	87	16.9	548	17.0
Other Services Received				
Education	128	57.9	1170	46.3
Other and Combinations	50	22.6	608	24.1
Speech and Hearing	7	3.2	278	11.0
Education and Speech	7	3.2	187	7.4
Health	25	11.3	121	4.8
Mental Health	1	.5	88	3.5
Social Services	2	.9	58	2.3
Mental Retardation	1	.5	15	.6

Note: N = Sample Size
Total children possible for SKI*HI overall, N = 5,178.
Total children possible for Utah, N = 715.
Actual Frequency of Home Visits data collected only for years 1987-1991.

Table 1 (Continued)

	Utah		Overall	
Variable	N	%	N	%
Presence of Other Handicaps				
Other Handicap Present	198	28.8	1227	24.7
Other Handicap Not Present	490	71.2	3747	75.3
Presence of Hearing Impaired Parent				
One or Both Hearing Impaired Parent	64	9.3	448	9.0
No Hearing Impaired Parent	624	90.7	4552	91.0
Type of Hearing Loss				
Sensorineural	459	68.6	4081	82.1
Mixed	61	9.1	393	7.9
Conductive	143	21.4	333	6.7
Not Yet Determined	6	.9	161	3.2
Severity of Unaided Hearing Loss				
No	88	14.1	166	3.7
Mild	106	17.0	388	8.7
Moderate	143	22.9	884	19.8
Severe	203	32.5	2005	45.0
Profound	84	13.5	1015	22.8
Severity of Aided Hearing Loss				
No	86	28.5	338	14.1
Mild	107	35.4	791	33.1
Moderate	67	22.2	660	27.6
Severe	39	12.9	524	21.9
Profound	3	1.0	78	3.1
Age at Onset				
At Birth	242	81.5	1544	71.8
Under 1 Year	26	8.8	309	14.4
1 Year	23	7.7	214	10.0
2 Years	3	1.0	63	2.9
3 Years and Over	3	1.0	19	.9
Communication Methodology				
Total Communication	89	13.8	2187	45.0
Aural/Oral	287	44.4	1470	30.2
Diagnostic/Prescriptive	251	38.8	1128	23.2
Other	20	3.1	76	1.6

Table 2

Mean, Standard Deviation and Median Ages or Intervals (in Months), 1979-1991

	Utah				Overall			
	M	*SD*	*Mdn*	*N*	*M*	*SD*	*Mdn*	*N*
Age of Identification (ID)	19.3	15.2	17	658	18.9	13.0	17	4848
Age of ID if Hearing Loss Occurred after Birth	18.8	12.7	17	49	20.2	12.2	18	582
Age of Program Start	26.7	16.5	24	685	26.4	14.1	25	5017
Age Hearing Aid Fit	25.8	16.2	22.5	460	23.8	13.1	22	4026
Age Communication Methodology Begun	32.7	15.1	31	252	28.9	13.6	28	2694
Age of Graduation	43.3	13.4	41	125	43.0	13.0	42	1481
Interval from Suspicion to Identification	5.9	7.8	3	600	5.7	7.4	3	4416
Interval from Identification to Program Start	7.3	10.3	3	645	7.2	9.2	4	4798
Interval from Suspicion to Program Start	12.4	11.7	9	574	12.7	11.1	9	4321
Interval from Program Start to Communication Methodology Choice	3.7	6.4	0	250	2.3	4.6	0	2679

Note: *N* = Sample Size
Total children possible = 5,178 for SKI*HI overall.
For Utah, Total children possible = 715.

Table 3

Identification Procedures, 1986-1989

Variable	Utah N	Utah %	Overall N	Overall %
ID Procedure				
Suspected by People	172	83.9	1106	84.9
ABR	33	16.1	152	11.7
Behavioral Audiometry	--	--	31	2.4
Immittance	--	--	7	.5
Crib-O-Gram	--	--	6	.5
Who Suspected Hearing Loss				
Caregivers	87	48.9	835	71.0
Medical Personnel	44	24.7	170	14.5
Educators	9	5.1	51	4.3
Other Specialists	31	17.4	34	2.9
Health/Human Services Personnel	1	.6	16	1.4
No Response/Unknown	6	3.4	70	6.0
Cause of Suspicion of Hearing Loss				
Auditory or Language Delay	107	60.1	777	66.1
Heredity	8	4.5	72	6.1
Meningitis	14	7.9	72	6.1
Birth Complications/Defects	16	9.0	64	5.4
Otitis Media/Middle Ear	7	3.9	27	2.3
Medical/School Screening	6	3.4	19	1.6
ADD/Behavior Problem	2	1.1	13	1.1
Health Problems	2	1.1	11	.9
Rubella/CMV	3	1.7	11	.9
High-Risk Register Card	3	1.7	3	.3
No Response/Unknown	10	5.6	107	9.1
Referred to Home-Based Program by Screening Agency				
Yes	31	93.9	158	77.5
No	2	6.1	37	18.1
No Response	--	--	9	4.4
Type of Referring Agency				
Medical	5	16.7	75	40.3
Audiology/Speech-Language Pathology	23	76.7	58	31.2
Educational	--	--	34	18.3
Health/Human Services	2	6.7	15	8.1
Parents	--	--	4	2.2

Note: N = Sample Size. Total sample possible = 1,404; for Utah = 211.

Table 4

Mean, Standard Deviation, and Median Pre-, Post-, and Predicted LDS Scores and PCIs, 1979-1991.

	Utah								Overall							
	Expressive				Receptive				Expressive				Receptive			
	M	SD	Mdn	N	M	SD	Mdn	N	M	SD	Mdn	N	M	SD	Mdn	N
Pretest Score	16.3	13.0	12	540	18.2	13.8	14	541	14.6	10.8	12	3307	15.9	11.3	12	3311
Posttest Score	28.5	14.7	24	539	31.2	14.8	28	541	26.3	14.1	24	3307	28.5	14.4	28	3311
Gain	12.2*		12		13.0*		14		11.7*		12		12.6*		16	
SMD	.9				.9				1.1				1.1			
Predicted Posttest Score	23.2**	13.7	20.5	524	25.5**	14.3	22.5	525	21.5**	13.0	18.7	3243	23.3**	13.8	20.5	3246
PCI	2.7	4.0	1.8	522	2.4	2.6	1.7	522	2.7	3.7	1.8	3238	2.6	3.2	1.8	3243

Note: Average treatment time=11.9 months for Utah.
Average treatment time=12.3 months for SKI*HI Overall.
N = Sample Size.
* = Differences between mean pre- and post-test scores were statistically significant.
SMD = Standardized mean difference (i.e., The difference between the means in standard deviation units. For example, the average score at posttest for the SKI*HI overall expressive LDS scores was approximately one standard deviation greater than the average score at the pretest.)
** = Differences between actual mean post-test scores and predicted mean post-test scores were statistically significant.

Table 5

Highest Level of Hearing Aid Usage, 1987-1991

	Frequencies and Percentages				Time (in Months) to Attain Highest Level of Hearing Aid Use					
	Utah		Overall		Utah			Overall		
	N	%	N	%	M	SD	Mdn	M	SD	Mdn
Less Than 1/4 Time	13	7.2	130	8.8	2.5	2.4	2	2.3	3.9	0
1/4 to 1/2 Time	8	4.4	111	7.5	2.1	3.8	.5	3.3	5.0	1
1/2 to 3/4 Time	15	8.3	153	10.4	3.7	4.7	2	4.6	5.3	3
3/4 to Full Time	25	13.9	222	15.0	3.9	3.5	3	4.4	5.4	3
Full Time	119	66.1	860	58.3	2.8	4.4	1	2.8	4.5	1
Total	180	100.0	1476	100.0	3.0	4.1	1	3.2	4.8	1

Note: N = Sample Size.

Table 6

Means, Standard Deviations, Medians, and Ranges for Child Auditory, Communication-Language, and Vocabulary Levels and Acquisition Times, 1987-1991

	Utah					Overall				
	Mean	SD	Median	Range	N	Mean	SD	Median	Range	N
Auditory (11 Levels)										
Beginning Level	4.9	3.7	4			3.2	3.1	2		
Ending Level	8.2	3.1	10			6.4	3.5	7		
Difference	3.3		6			3.2		5		
Time Interval (in Months) to Attain Ending Level	5.4	5.2	4	0-24	238	5.2	5.8	3	0-31	1422
Communication-Language (12 Levels)										
Beginning Level	5.2	3.3	5			4.0	2.9	3		
Ending Level	8.1	3.1	9			7.2	3.0	8		
Difference	2.9		4			3.2		5		
Time Interval (in Months) to Attain Ending Level	6.0	5.8	5	0-27	260	6.5	6.7	5	0-48	1633
Vocabulary (8 Levels)										
Beginning Level	2.6	2.3	1			2.4	2.1	1		
Ending Level	4.4	2.6	4			4.5	2.6	5		
Difference	1.8		3			2.1		4		
Time Interval (in Months) to Attain Ending Level	6.2	6.2	4	0-27	255	6.4	6.6	5	0-41	1565

Note: N = Sample Size.

Table 7

Means, Standard Deviations, and Medians for Number of Skills Acquired by Parents and Time in Months to Acquire Skills, 1987-1991

	Utah				Overall			
Skill	*M*	*SD*	*Mdn*	*N*	*M*	*SD*	*Mdn*	*N*
				Number of Skills				
Auditory (11 skills)	5.0	3.2	4	202	4.6	3.1	4	1327
Communication (15 skills)	7.6	4.7	7	223	8.1	5.0	8	1493
Aural-Oral (9 skills)	4.2	2.8	4	137	4.7	2.9	5	702
Total Communication (20 skills)	5.9	4.3	5	55	6.7	5.0	6	607
Cognition (12 skills)	4.0	3.1	3	50	4.4	3.4	3	265
				Time in Months				
Auditory	6.6	5.1	5	164	6.4	5.9	5	1057
Communication	5.9	4.8	5	197	6.0	5.1	5	1299
Aural-Oral	4.4	4.0	3	97	5.0	4.7	4	547
Total Communication	5.3	4.0	5	45	6.4	5.7	5	561
Cognition	3.7	3.7	3	37	4.6	4.9	3	200

Note: *N* = Sample Size.

Table 8

Means, Standard Deviations, Medians, and Ranges for Treatment Amount, Treatment Density, and Gaintime (in Months)

	Utah					Overall				
Variable	M	SD	Mdn	Range	N	M	SD	Mdn	Range	N
Amount	15.1	9.1	14	2-57	516	14.8	9.9	13	1-78	3231
Density	2.9	1.5	3	.2-12	207	2.6	1.4	2.5	.1-15	1229
Gaintime	11.9	8.1	10	1-54	526	12.3	8.7	9	1-60	3259

Note: N = Sample Size.
Amount = time between program start and post-test, 1979-1991.
Density = actual number of visits per month, 1987-1991.
Gaintime = time between pre-test and post-test, 1979-1991.

Table 9

Frequencies and Percentages of Children for Placement After Home Programming, 1986-1989

Placement			Utah		Overall	
			N	%	N	%
Self-Contained Class for the Hearing Impaired			139	66	547	39
Day School for the Hearing Impaired			--	0	211	15
Mainstreamed-Integrated Classroom			24	11	167	12
Other Services	Utah	Overall	24	11	83	6
Class for Mentally Handicapped	1	12				
Class for Severely Impaired	2	5				
Non-Categorical Class	16	46				
Developmentally Delayed Class	--	7				
Other	5	13				
Individual Speech-Language-Auditory Services			1	<1	78	6
Headstart-Homestart-Preschool			9	4	34	2
Residential Program			--	0	31	2
In Home-No Services			2	1	22	2
Day Care			2	1	8	1
Transition Program			--	0	3	<1
Hasn't Graduated			--	0	73	5
Unknown/Not Reported			10	5	278	20
Total Placements			211	100	1535	110

Note: N = Sample Size.
Total children possible SKI*HI overall = 1404; Utah = 211.
Total percentages may be greater than 100%, because some children have more than one placement setting.

Table 10

Frequencies and Percentages of Children by Current Placement for 1986-1989

	Utah		Overall	
Current Placement	N	%	N	%
Public School	41	19	188	13
Self-Contained Class for Hearing Impaired	2	1	163	12
Day School for Hearing Impaired	2	1	157	11
Mainstreamed-Integrated Class	1	<1	119	8
Day School for Deaf and/or Blind	99	47	111	8
Self-Contained Plus Other Classroom	--	--	44	3
Residential Program for the Deaf	--	--	42	3
Non-Categorical Self-Contained Classroom	8	4	38	3
Preschool for the Hearing Impaired	--	--	33	2
Preschool Plus Other Services	2	1	34	2
Mainstreamed Plus Other Services	4	2	24	2
Special Individual and Group Program Combinations	--	--	11	1
In Home-No Services	2	1	11	1
Program for Multiply Handicapped	--	--	10	1
Deceased	4	2	9	1
Not Graduated	1	<1	73	5
Do Not Know/Moved	45	21	275	20
No Response/Can Not Tell	--	--	62	4
Total	211	100	1404	100

Note: N = Sample Size.
Total children possible for SKI*HI overall = 1404; for Utah = 211.